WATER WORKS & SEWERAGE

A GILLETTE ABC PUBLICATION

Vol. 86, No. 6 JUNE, 1939 L. H. Enslow Editor

PITTSBURGH WATER METERS

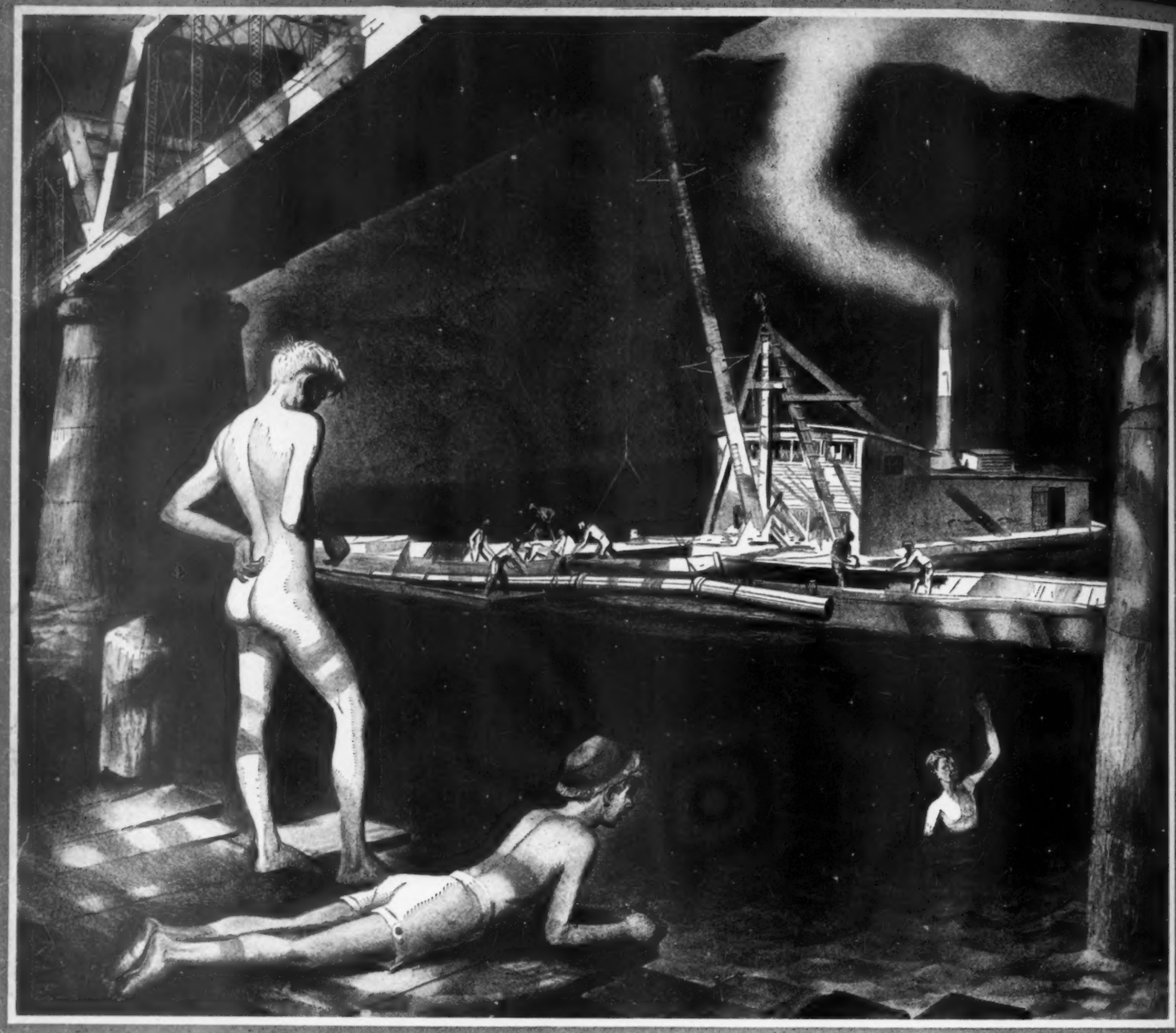
IMO

One of the foremost features of the Pittsburgh IMO Meter is the absolute lack of noise when it is operating. Any water works man who has attempted to placate a consumer, annoyed by the clicking sound of a water meter telegraphed through the house, will appreciate this feature. Many purchases of IMO Meters have been based on this attribute alone.

An annoyed consumer is never a satisfied one. With the increasing attention being devoted to better public relations, the elimination of noisy water meters should be given serious consideration.

The Pittsburgh IMO Meter can never become noisy. Smooth turning rotors, precision cut to mesh perfectly, revolve with a semi-floating action and water flows through the measuring chamber in a straight line without any turbulence. Wear on rotors or measuring chamber has been shown to be negligible. This basic construction precludes the possibility of the IMO Meter ever becoming noisy.

NO OTHER METER EVER GIVEN



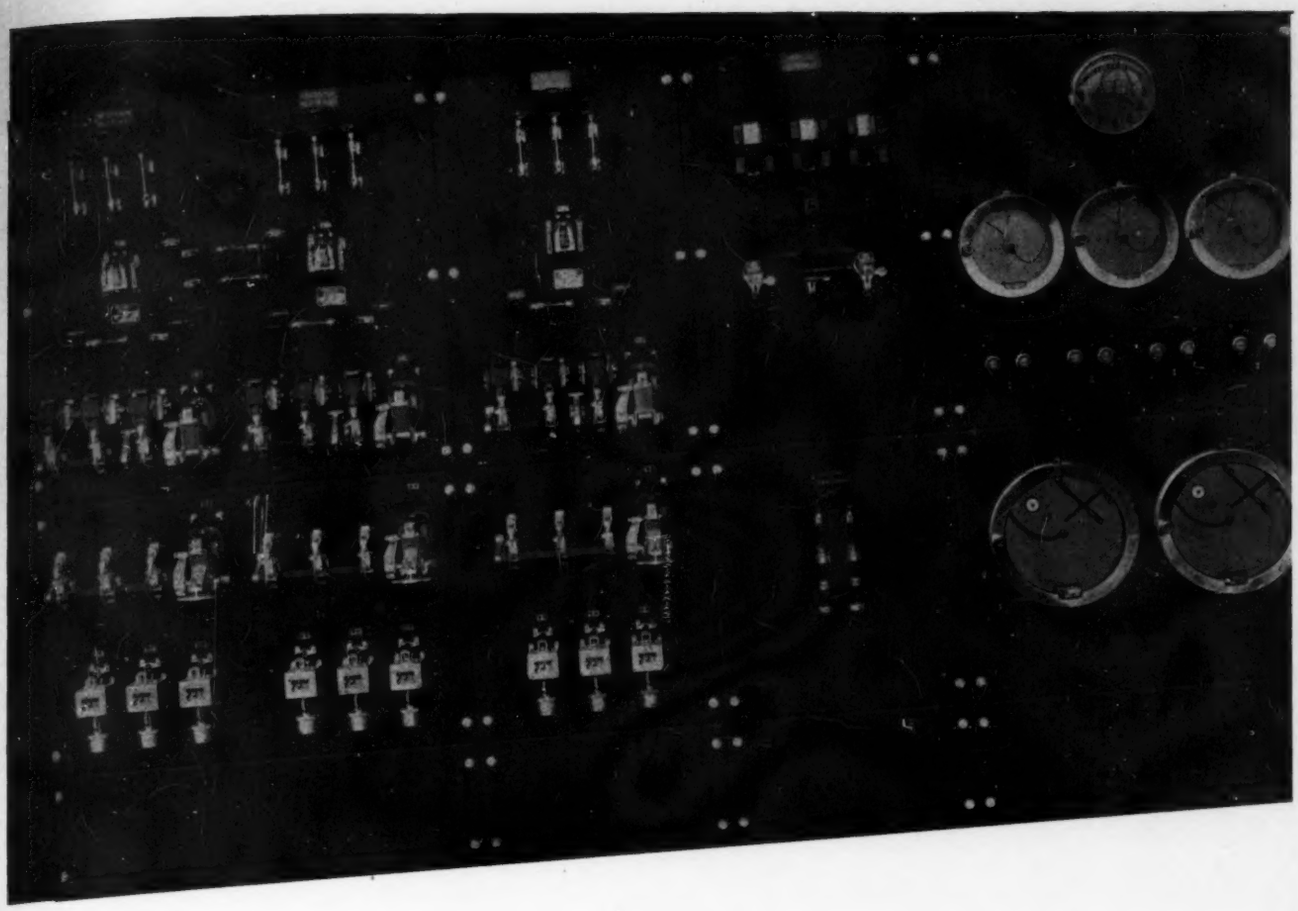
Lithographed on stone by James E. Allen, Copyright 1939, U. S. Pipe & Foundry Co.

Summer is the tonnage peak of pipe line construction—underground, submarine and outfall. You can quickly obtain U. S. Cast Iron Pipe from any one of our fourteen plant and storage yards throughout the country, stocked with pipe and standard fittings—U. S. Super-de Lavaud, centrifugally cast in a metal mold *without chill,* or U. S. Pit Cast.

U.S.
cast iron
PIPE

United States Pipe & Foundry Co., Burlington, N. J.

Plants and Sales Offices throughout the United States.



¶ Designed for a Mid-Western community, this 4 section Water Works Pumping Panel provides reduced voltage starting and protection for 1-50 HP and 2-75 HP, 440 Volt, 3 Phase, 60 Cycle A.C. squirrel cage booster pump motors.

¶ The board includes incoming line and lighting equipment along with required recording and metering equipment.

¶ These pumps are operated by D. C. Pressure Regulators over telephone wires from a Pump House at a remote point.

¶ Provision is also made for interchanging the Pressure Regulators with the starters.

¶ Provision is made so that any pump may be operated manually at the operator's discretion.

¶ The entire board is made of Ebony Asbestos Wood, on self-supporting angle iron frames, and all recording and indicating instruments are of flush mounted type with chromium finish. The attractive appearance of this Panel is not the least of its features.

¶ Our nearest office will gladly co-operate with you on any electrical control problem in the water works or sewage disposal plant field.

OFFICES IN PRINCIPAL CITIES

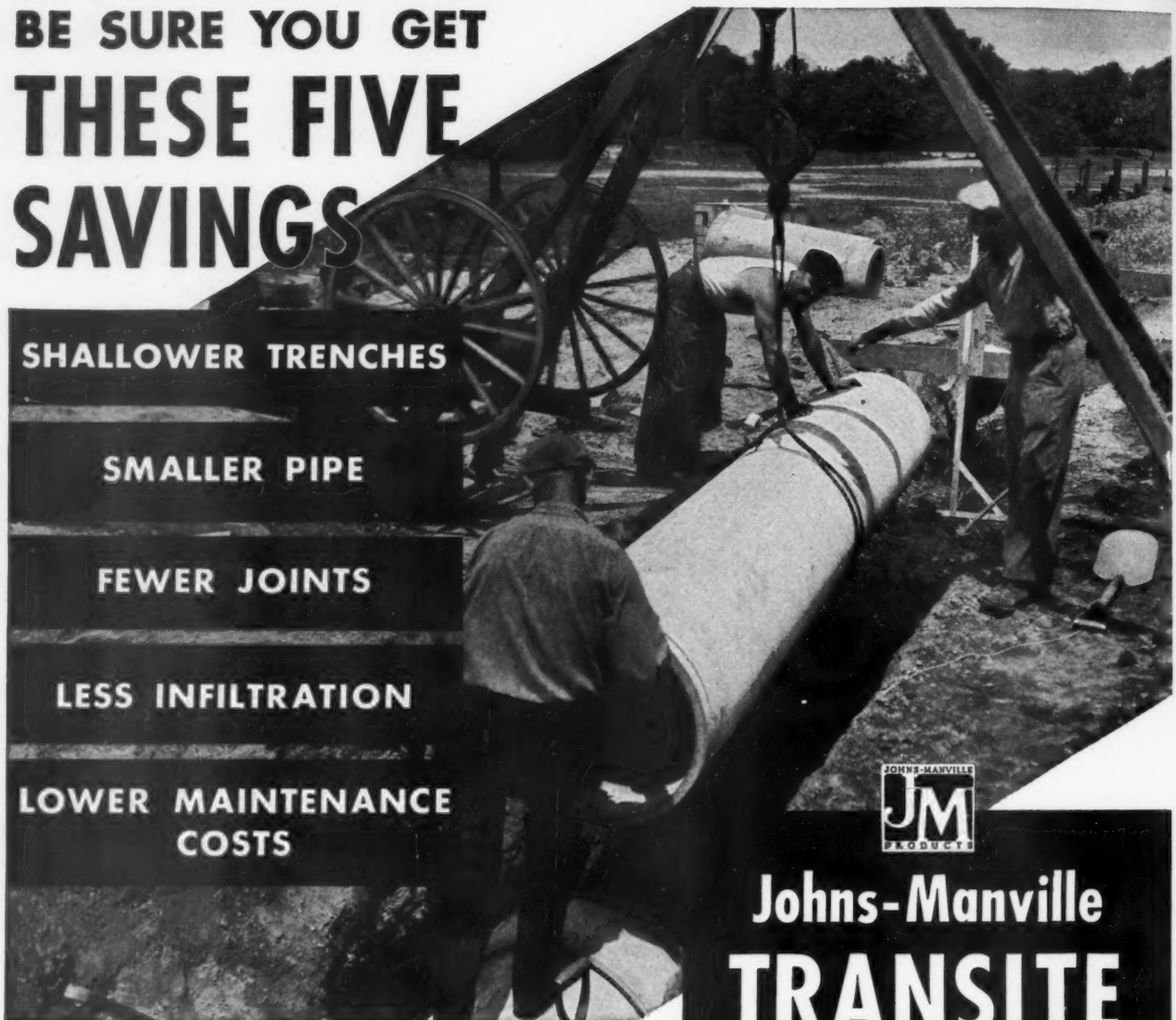
THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS AND SEWERAGE, June, 1939. Volume 86. Number 6. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States and Canada, $2.00 per year; Foreign, $3.00 per year. Copyright, 1939. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

ON YOUR NEXT SEWER LINE

BE SURE YOU GET THESE FIVE SAVINGS



SHALLOWER TRENCHES

SMALLER PIPE

FEWER JOINTS

LESS INFILTRATION

LOWER MAINTENANCE COSTS

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PIPE

The MODERN Material for Sewer and Water Lines

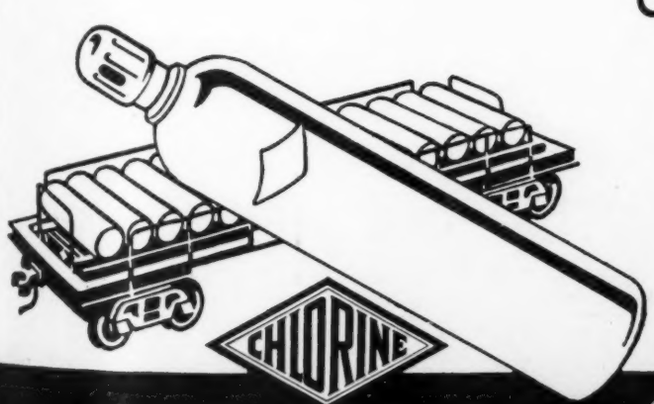
IN ALL TYPES of municipal sewer systems, J-M Transite Sewer Pipe provides important savings on the above five points. Asbestos-cement in composition, this durable pipe comes in long, easily installed lengths that reduce the number of joints in the line. Its unusual corrosion-resistance keeps maintenance low. Joints stay tight. And in many cases, because of Transite's unusually high carrying capacity, grades can be flatter, trenches shallower, or smaller pipe may be used.

For details, send for Transite Sewer Pipe brochure TR-21A. And, if you are interested in low-cost water transportation, get the TransiteWater Pipe brochure TR-11A. Johns-Manville, 22 East 40th St., New York, N.Y.

FREE BOOK

gives convincing facts...Write for your copy

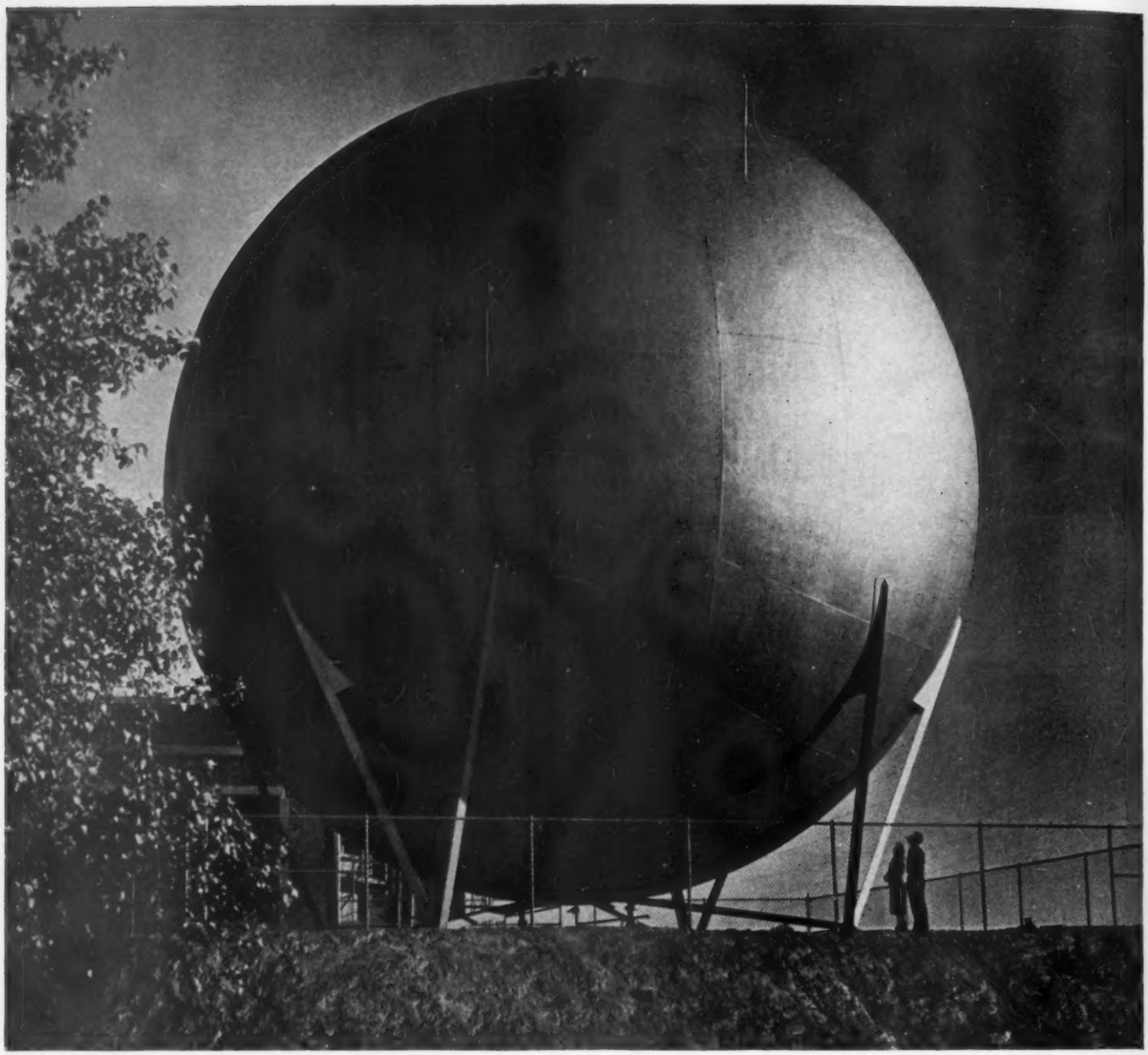
Make sure they always have Pure water



—With the sure and dependable aid of Diamond Liquid Chlorine—used and preferred the nation over for its absolute uniformity the year around. Quick deliveries in 100 and 150 pound cylinders are always assured through your local Diamond distributor. Larger quantities are shipped direct from the Diamond plants at Painesville, Ohio.

DIAMOND ALKALI COMPANY, Pittsburgh and Everywhere

DIAMOND *Liquid* CHLORINE



HORTONSPHERES for Storing Sewage Gas

AN increasing number of sewage treatment plants are installing facilities for utilizing the gas produced in the digestion process. In order to do this efficiently, it is often necessary to install a gas holder to iron out the irregularities in the supply collected from the digesters.

The Hortonsphere has proved to be a desirable type of container for this purpose. It is relatively small in size and pleasing in appearance. There are no moving parts to require maintenance or water seals to heat. The shell of the holder does not come in contact with the sewage, eliminating discoloration and the need for frequent repainting.

The City of Cleveland, for example, has Hortonspheres at two of its three treatment works. The one illustrated above holds 200,000 cu. ft. of gas at 29.9 lbs. per sq. in., and supplies two 400 h.p. gas engines driving blowers that compress air for the aeration process. The cooling water and exhaust heat from the engines maintain the proper temperature in the digesters. In numerous other cities sewage gas has also been used to heat the plant and to generate power for pumping sewage.

For information on Hortonspheres for gas storage service, or other steel plate structures, please address our nearest office.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 Old Colony Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St. Bldg.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	2919 Main Street	San Francisco	1003 Rialto Bldg.
Dallas	1479 Liberty Bank Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

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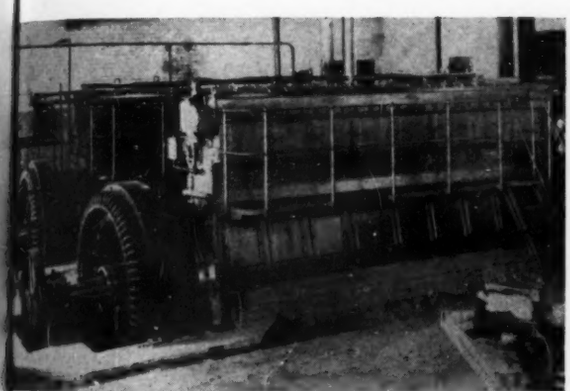
DOES A BETTER JOB

FOR YOU

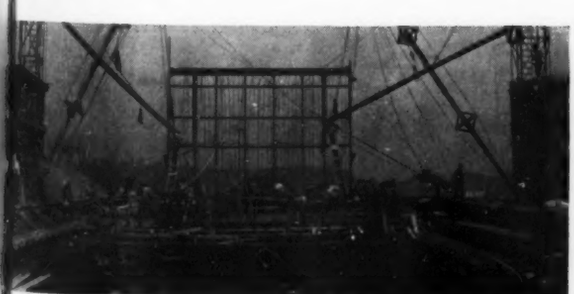


AMERICAN HAMMERED PISTON RINGS increase power and reduce maintenance costs. This Cooper-Bessemer Diesel engine is part of the power plant which supplies light for street lighting and power for the water works in Gainesville, Texas. Our engineers will be glad to confer with you on special requirements.

KOPPERS BUILT-UP ROOFS are recommended for water-cooled or spray pond roofs used in conjunction with air conditioning systems. They prevent an overload of the city's supply and sewage facilities. The water is recycled through the system. Write for your copy of "Koppers Specifications." Koppers Company, Pittsburgh, Pennsylvania.

KOPPERS MEMBRANE WATERPROOFING is widely used to protect concrete structures of all kinds from the destructive action of water; and to waterproof conduits, filter beds and clear wells.

KOPPERS MEMBRANE GASPROOFING prevents the escape of gas from sludge digestion tanks.

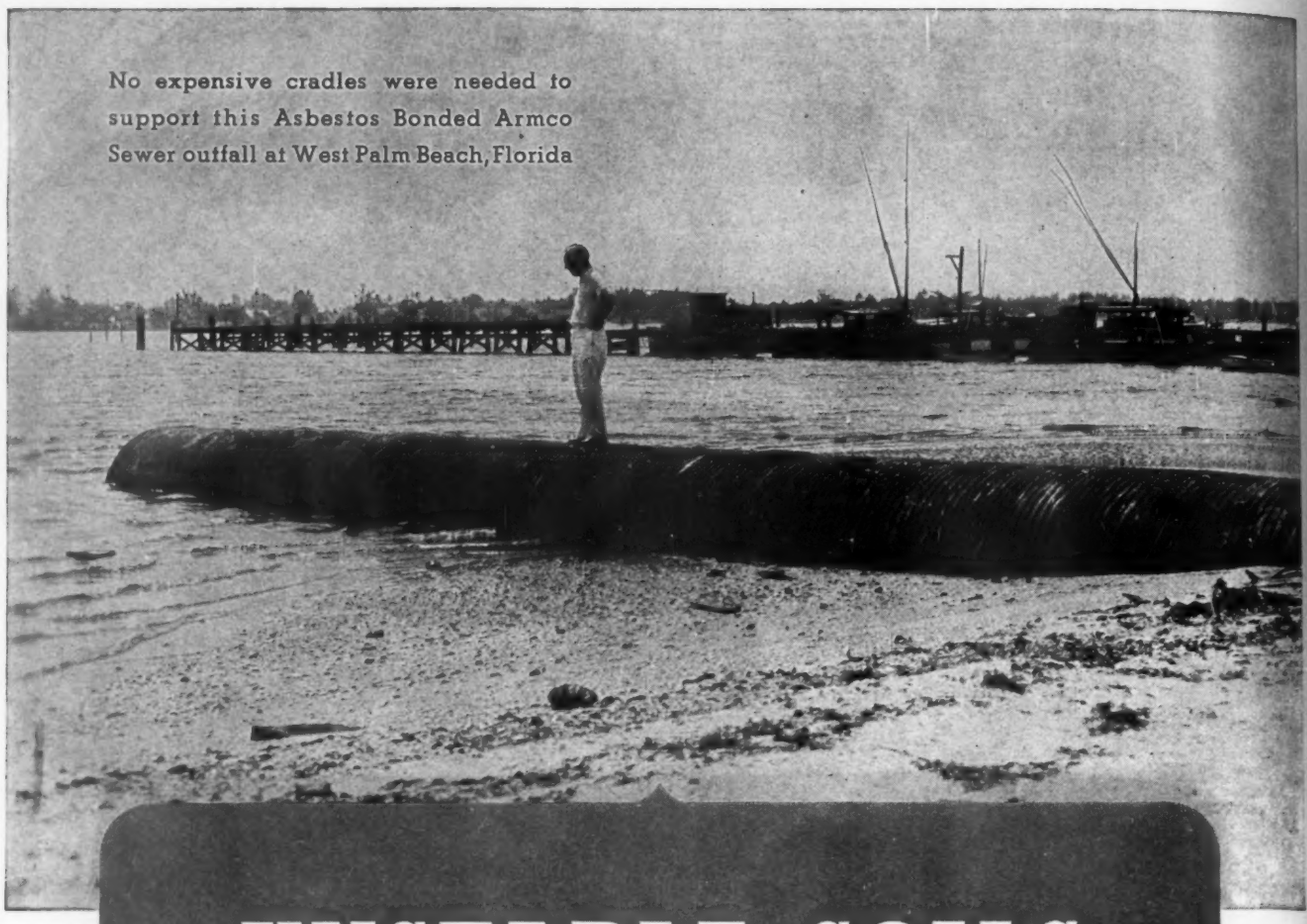


KOPPERS *products*

FOR FOUNDATION WORK and other construction developments, Koppers offers you expert engineering, skilled crews and adequate field equipment. Koppers, maintaining one of the largest engineering staffs in the country, requests an opportunity to prepare plans, specifications and estimates on any project you have under consideration.

Fire Plugs . . . Tarmac for Paving . . . Floor Stands . . . Valves . . . Fast's Self-aligning Couplings . . . D-H-S Bronze Stems . . . Pressure-treated Timber . . . Engineering and Construction Work . . . Bituminous-base Paints.

KOPPERS COMPANY • PITTSBURGH



UNSTABLE SOILS

won't disjoint an *Armco Sewer*

● Your "joint troubles" are over when you specify Asbestos Bonded Armco Pipe for sewers. Because of its flexibility, long lengths and sturdy connections, this improved pipe readily adjusts itself to soft, yielding foundations. No expensive piling or cradles are necessary to hold it in place.

Best of all, Asbestos Bonded Armco Sewer Pipe definitely solves your durability problem. Made of rust resisting ARMCO Ingot Iron, it boasts a *30-year background* in sanitary and combined sewer service. Then too, Asbestos Bonded Pipe is paved in the bottom and fully coated with a special bituminous material used successfully for 12 years. This bituminous material is "bonded" to the pipe in such a manner that it will stick indefinitely in handling and in service.

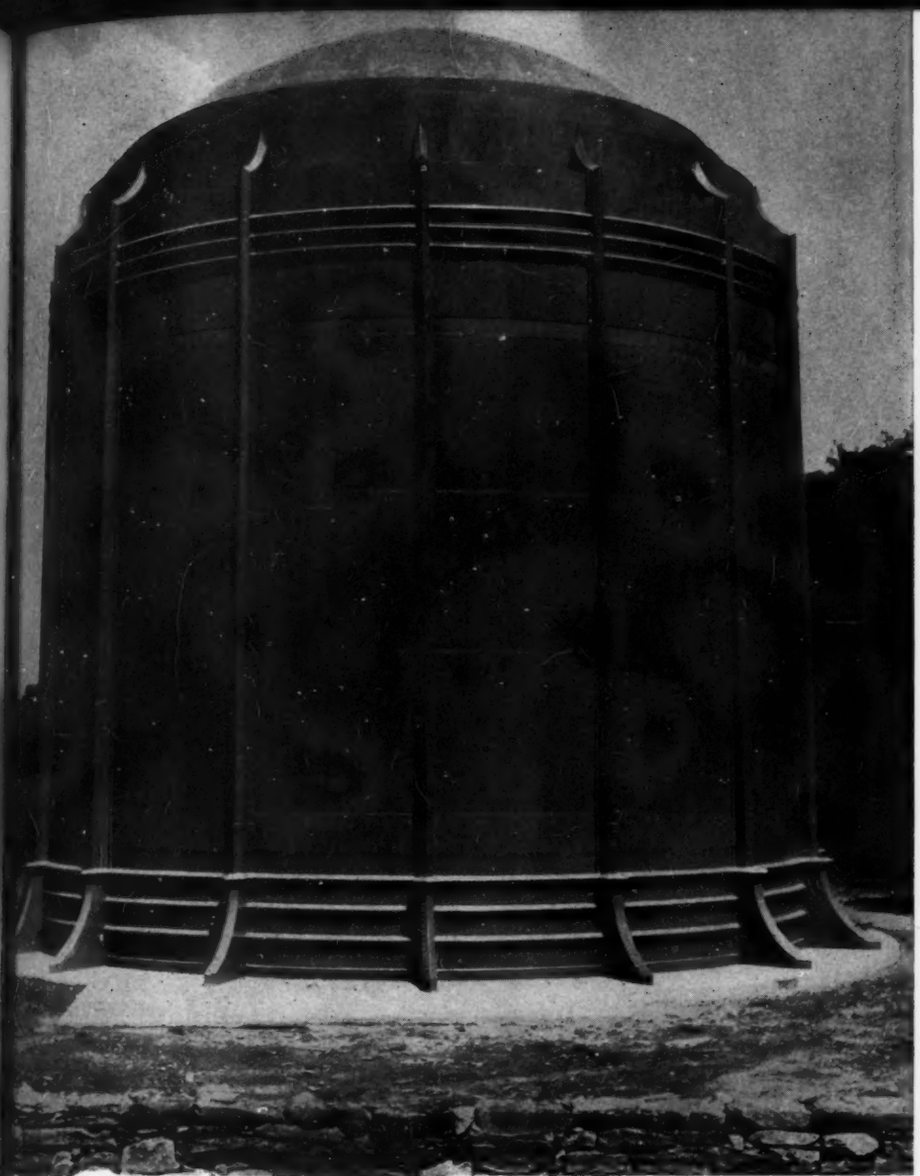
You'll find complete, useful data on this improved sewer pipe in the new 48-page Armco Sewer Book. A postal card or letter will bring your copy promptly and without obligation. Armco Culvert Mfrs. Assn., 704 Curtis St., Middletown, O.

ARMCO

Asbestos Bonded

ARMCO SEWER PIPE

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS



Beautiful

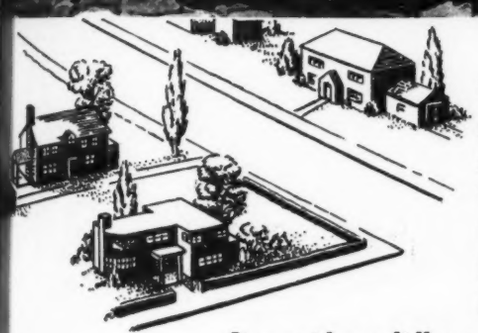
WESTCHESTER, N.Y.

APPROPRIATELY SELECTS A

P.D.M

STANDPIPE

for its citizens



This handsomely-designed Standpipe—installed by P·DM for The Westchester Joint Water Works No. 1 at Mamaroneck, N. Y.—fulfills a two-fold plan. It provides solidly practical *better water service* for the consumer, and at the same time successfully ornaments and blends with the high-value section in which it is situated.

Welded in construction, built of lifetime materials with exacting P·DM craftsmanship, this modern Standpipe is a typical example of Pittsburgh-Des Moines' engineering and designing skill.

Let us discuss *your* requirements for modern water storage or handling equipment! We will gladly provide consultations and preliminary estimates, without obligation of any kind.

P·D·M ALWAYS ON THE JOB

DESIGNERS, FABRICATORS AND ERECTORS OF

Elevated Steel Tanks . . . Steel Standpipes . . . Steel Reservoirs . . . Surge Tanks . . . Penstocks . . . Water Treating Plants . . . Pipe Lines . . . Steel Swimming Pools . . . Steel Grandstands . . . Refuse Incinerators . . . Highway Bridges . . . General Steel Construction.

Descriptive Bulletins on the items in which you are interested promptly furnished free on request.

PITTSBURGH · DES MOINES STEEL CO.

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NEW YORK, ROOM 918 99 270 BROADWAY CHICAGO, 1222 FIRST NATIONAL BANK BUILDING

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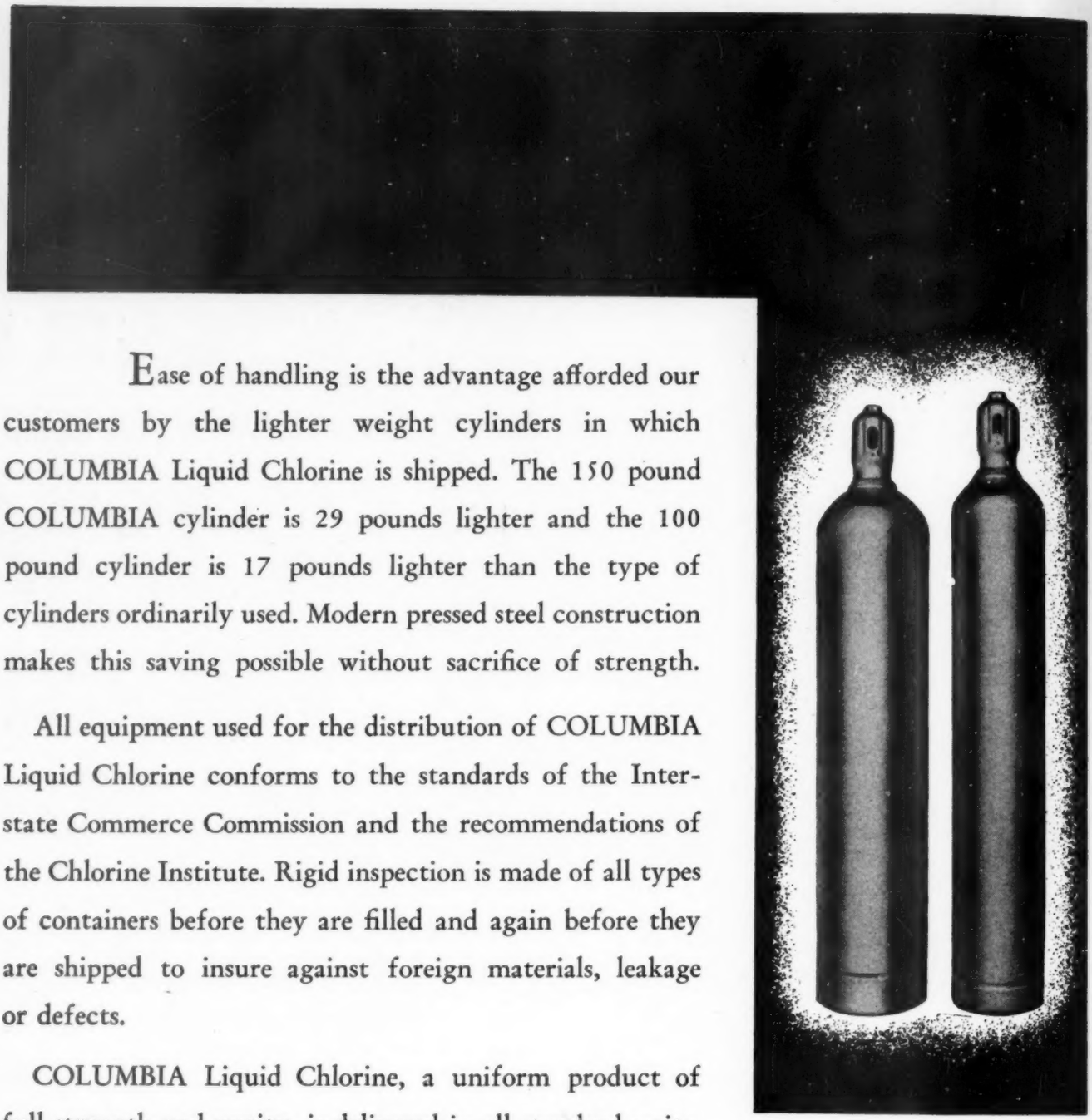

Ease of handling is the advantage afforded our customers by the lighter weight cylinders in which COLUMBIA Liquid Chlorine is shipped. The 150 pound COLUMBIA cylinder is 29 pounds lighter and the 100 pound cylinder is 17 pounds lighter than the type of cylinders ordinarily used. Modern pressed steel construction makes this saving possible without sacrifice of strength.

All equipment used for the distribution of COLUMBIA Liquid Chlorine conforms to the standards of the Interstate Commerce Commission and the recommendations of the Chlorine Institute. Rigid inspection is made of all types of containers before they are filled and again before they are shipped to insure against foreign materials, leakage or defects.

COLUMBIA Liquid Chlorine, a uniform product of full strength and purity, is delivered in all standard units, including ton tanks, 15 ton and 30 ton cars.

COLUMBIA

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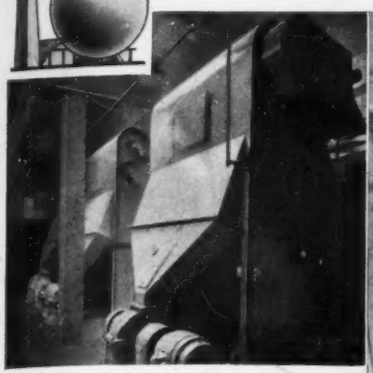
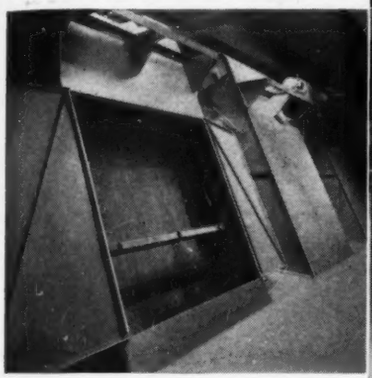
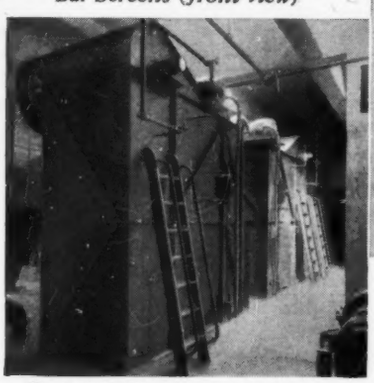
REX SANITATION EQUIPMENT
IN THE TALLMAN'S ISLAND PLANT



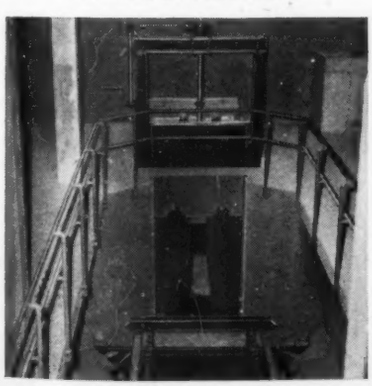
Rear view of Bar Screens and Screenings Shredders



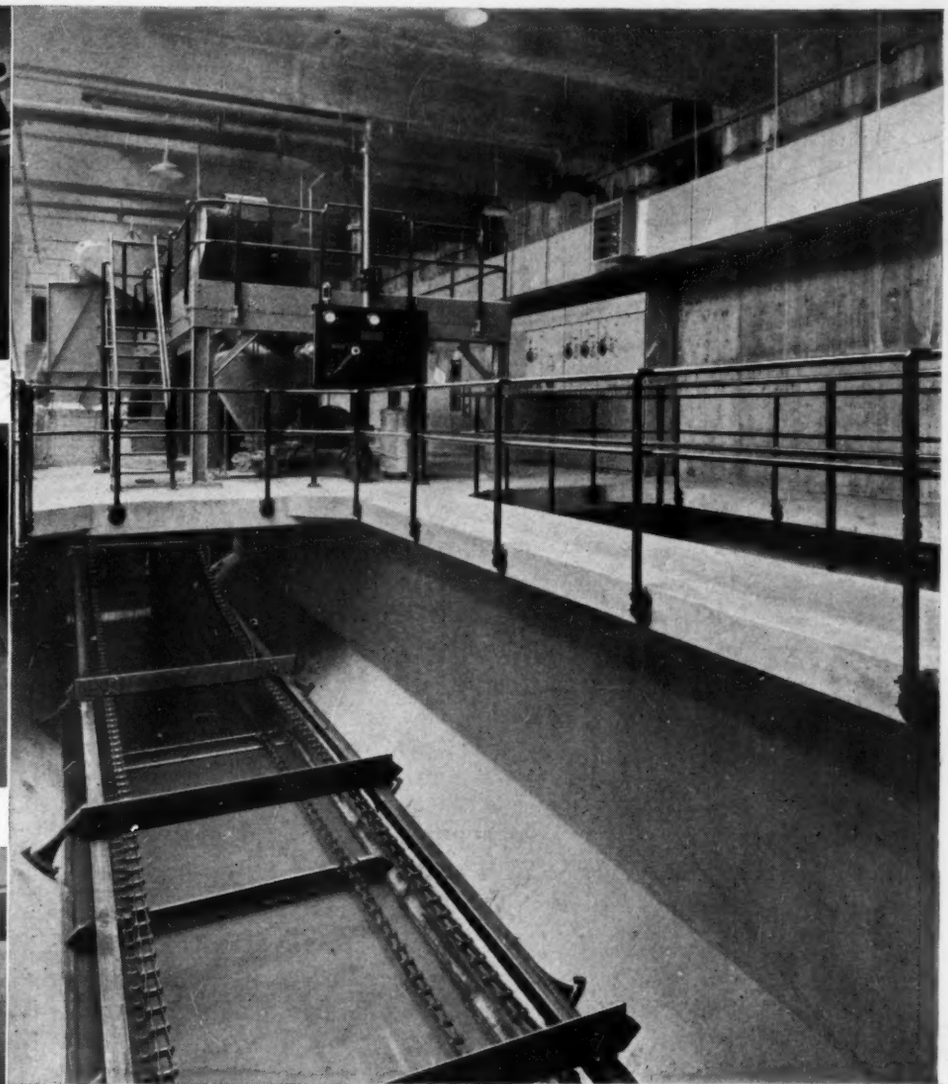
Three Rex Mechanically Cleaned Bar Screens (front view)



Each Grit Collector also has a V-Bucket Grit Elevator



Foot end of Rex Grit Collector showing Proportional Weir



One of three Rex Grit Collectors, each with Rex Separate Grit Washer, at Tallman's Island Sewage Disposal Plant.

Built especially for serving the New York World's Fair area, the Tallman's Island sewage treatment plant is another outstanding plant to use Rex Mechanically Cleaned Bar Screens and Rex Grit Collectors and Washers. To municipalities and consulting engineers, this evidence of continued preference is the strongest recommendation for the use of Rex Sanitation Equipment in your plant, new or old. Write for catalogs on any or all of the items in the Rex Line listed below.

Rex Grit Collectors and Washers . . . Rex Triturators . . . Rex Tow-Bro Sludge Removers—Rex Conveyor Sludge Removers . . . Rex Mechanically Cleaned Bar Screens—Rex Slo-Mixers.

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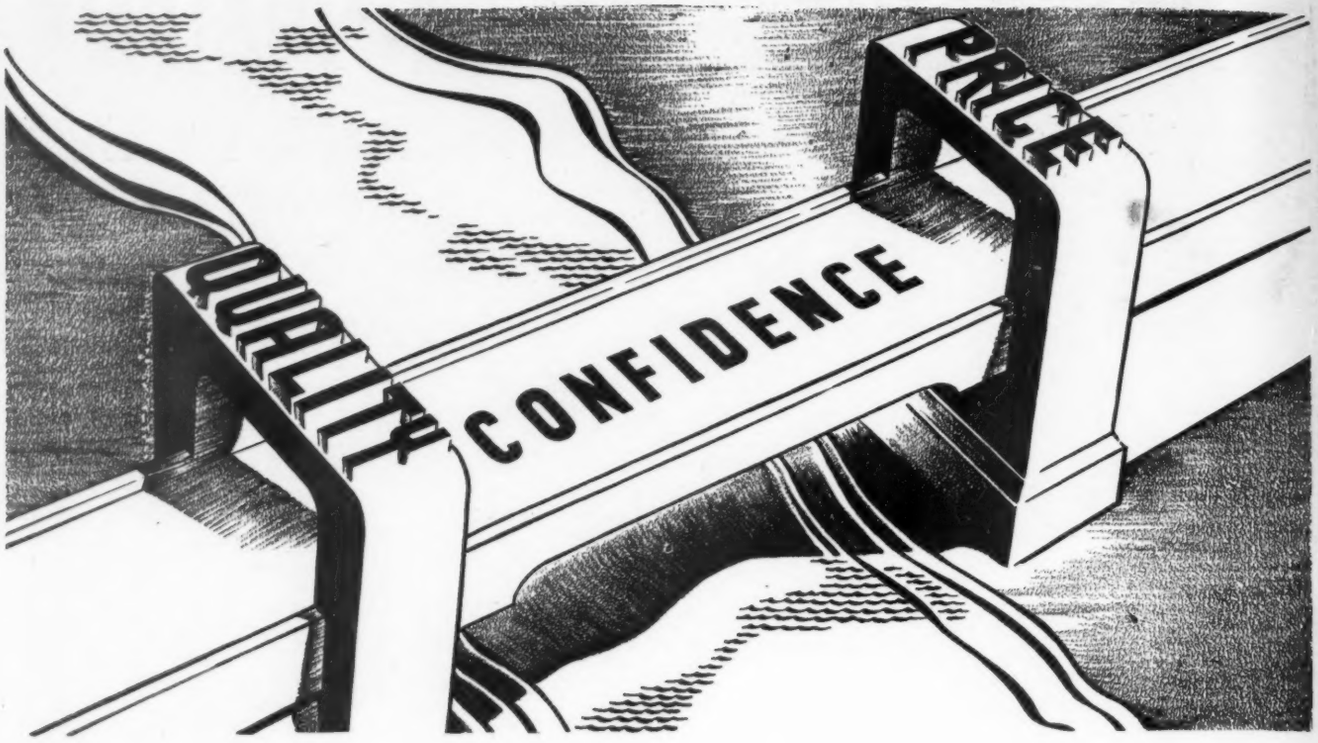
Quick delivery from stock on chains, sprockets, and transmission equipment

REX SANITATION EQUIPMENT

CHAIN BELT COMPANY of Milwaukee



HYDRODARCO* Builds a Bridge of Confidence . . . . . Supported by Quality and Price

One thing common to all users of activated carbons is *confidence* in Darco — confidence that no matter what the field, Darco produces the finest results at the most economical cost!

In dry cleaning, for instance, Darco has won pre-eminence by enabling the cleaner to sweeten the solvent, so that it can be used longer without giving clothes that "dry cleaning odor." In making wines, Darco's pre-eminence is based on getting clearer, brighter colors. In sugar refining, Darco is pre-eminent because it solves the problem of producing higher yields of pure, white crystals.

And in the waterworks field, Hydrodarco* solves the problem of palatability control by giving maximum removal of tastes and odors.

Hydrodarco quality meets any test, any time — with conclusive results. Yet Hydrodarco prices are *lowest!*

Write today for further information, and for a working sample of Hydrodarco— the activated carbon specially made for water treatment.

*Reg. U. S. Pat. Off.

•

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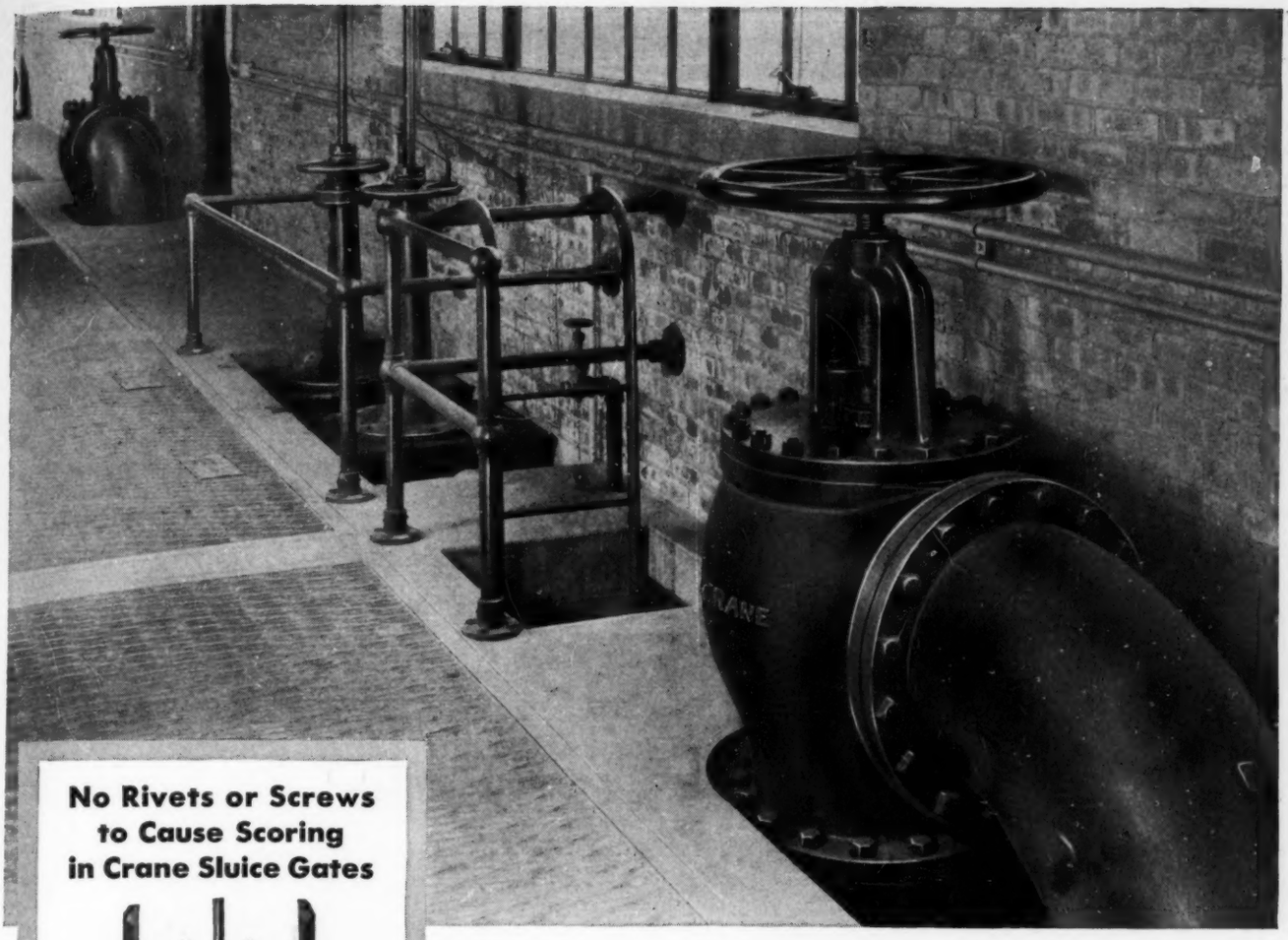
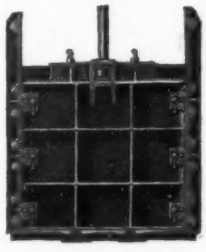


No Rivets or Screws to Cause Scoring in Crane Sluice Gates



There are no rivets or screws in Crane Sluice Gate seats to work loose and interfere with smooth operation—to cause burrs that cut deeply into seating surfaces. The Crane method of seat mounting avoids this danger. Crane bronze seats are rolled into dovetail grooves of ample section machined in the face of the disc. After rolling seat facing into the grooves, seating surfaces are machined to a smooth tool finish.

That's just one of the many reasons why Crane Sluice Gates give superior service—smooth and positive through long years. Crane's vast experience and facilities in engineering water control equipment back up the dependability of every part—frame, disc, guide rails, operating mechanism—assure faithful performance. Consult your Crane Representative.

BECAUSE OF VALVES A CITY WILL BE SAFE

IT takes valves—lots of them—to furnish pure water to cities—to dispose of disease breeding wastes. Here on an air line leading to the aerating tanks in a large sewage treatment plant are Crane No. 353 Angle Valves—a whole line of them—selected for this duty because of the constant, reliable, trustworthy service Crane Valves may be expected to perform.

But whether it's a sewage treatment plant or a filtration plant—whether the service is shutting off a main—or handling chlorine gas for water sterilization—whether the valve is intended to control the flow of air or water, steam or gas—there is a Crane valve just built for that job.

The Crane No. 52 Catalog is designed to help you solve your problems in flow control. It gives complete information on valves built to A. W. W. A. specifications for waterworks service—and in addition it contains a gold mine of information on waterworks problems for the engineer or superintendent. Make it a habit to check with your Crane Catalog on any valve or piping item you may need—you will find it listed and described in the 38,000 items contained in this book. You will find, too, that Crane nation-wide service means stocks quickly available to meet your demands.

CRANE

CRANE CO., GENERAL OFFICES
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

INSTALLATION COSTS A simple, easily operated chain puller is the only tool needed for assembly of Simplex Couplings. Unskilled crews can lay Transite rapidly and economically, as fast as the trench is opened. Job shown here is in Washington State.

HANDLING COSTS Transite's long, light lengths keep handling costs low. Smaller trucks carry more footage; loading and unloading is faster, easier. More than 16,000 feet of Transite are used on this Pennsylvania line.

Which of These Problems Will You Meet Next?

CORROSIVE SOILS Corrosion has little effect on Transite's asbestos-cement structure. Even in unusually acid or alkaline soils, it assures minimum upkeep costs. Above line is part of a 9,000-foot Texas system.

DEEP TRENCHES In deep trenches like the above, Transite's strength and durability protect against breakage. Over ten miles of Transite are used on this California system.

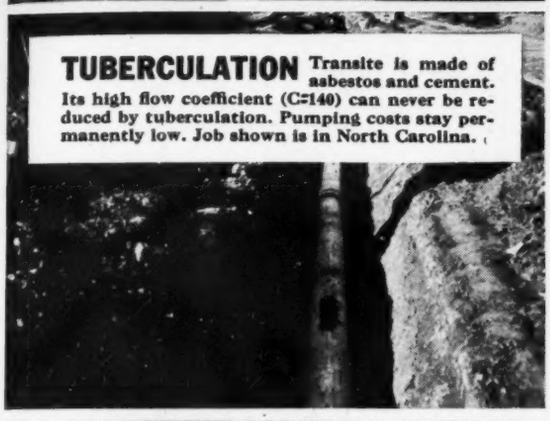
WIDE SWEEPS Flexibility of Simplex Couplings permits wide sweeps to be made with straight lengths of Transite. No special fittings are needed, joints stay tight. Above job in Maine.

ELECTROLYSIS Electric current from power or street-railway lines cannot damage Transite. It is inorganic, immune to electrolysis. This system is in Winnipeg, Canada.

JOHNS-MANVILLE PRODUCTS

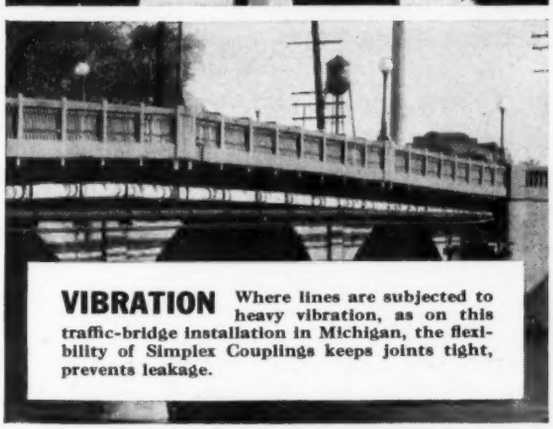
Johns-Manville TRANSITE

WET TRENCHES Assembled cold, Simplex Couplings require no costly heating equipment on the job. Work goes rapidly, even in wet trenches such as those encountered on this New York State job.



TUBERCULATION Transite is made of asbestos and cement. Its high flow coefficient (C=140) can never be reduced by tuberculation. Pumping costs stay permanently low. Job shown is in North Carolina.

JOINT LEAKAGE Simplex Couplings form bottle-tight joints that stay tight as long as the line is used . . . give positive protection against water losses due to joint leakage. This line is in Arizona.



VIBRATION Where lines are subjected to heavy vibration, as on this traffic-bridge installation in Michigan, the flexibility of Simplex Couplings keeps joints tight, prevents leakage.

GET SET FOR SAVINGS WITH TRANSITE!

SOONER OR LATER, you're going to run into one—probably several—of these conditions on your water systems. How *economically* you meet them depends largely on the pipe you specify. That's why you should have all the facts on J-M Transite Pipe.

This asbestos-cement water carrier combines every advantage necessary for long, economical water-carrying service. Strong and durable, it is exceptionally resistant to soil corrosion, immune to electrolysis. Being non-metallic, Transite cannot tuberculate—its high delivery capacity (C = 140) can never be reduced by this costly economic evil. Bottle-tight Simplex Couplings eliminate joint leakage. And, because of its long lengths, light weight and speed of assembly, the installed cost of Transite Pipe is surprisingly low.

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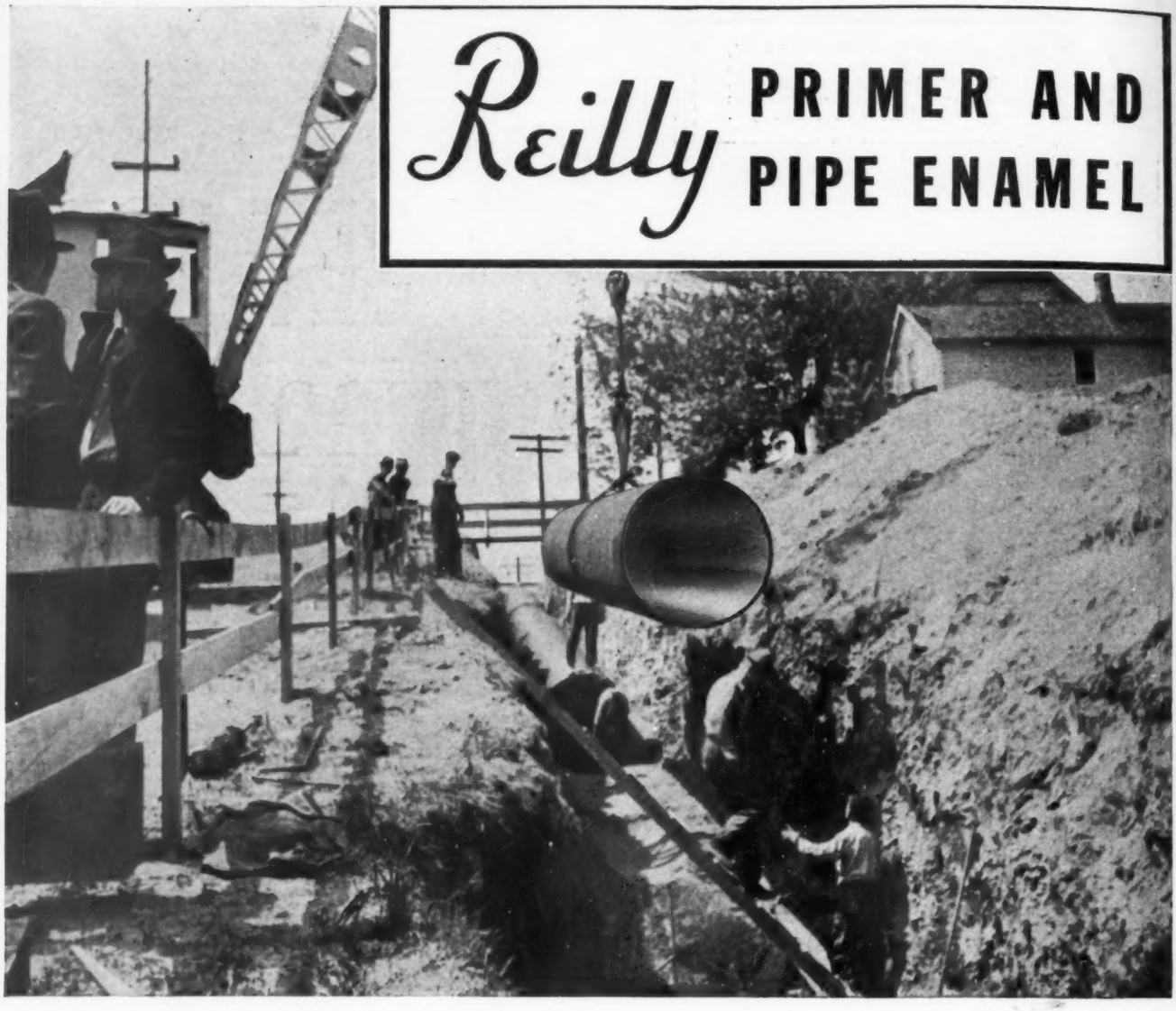

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WATER WORKS & SEWERAGE

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Coming! Articles

"The Design of Air Distribution Systems for Activated Sludge Plants"
An especially valuable contribution dealing with a topic about which little concrete information has been available. Design, considerations with respect to sufficiency vs. first costs vs. operating savings over a period of years are based on Chicago studies supplemented by experience.

"America's Filtration Plant of Tomorrow"
To our thinking such is Milwaukee's new plant now in operation. Its many novel features will be covered, several in detail, together with early operating experiences recounted by the man who fought many a battle before the new plant was a realization.

"On—Watching the Cash Register"
In which a superintendent studies and analyses the economic reasonableness of meter testing frequency, maintenance limitation, and other considerations. The author has sought to determine what constitutes over-all economy in metering practice, based on facts rather than fancy.

"Frosted Sludge"
Here is a new idea in sewage treatment. The suggested scheme, of dewatering sludges by artificial quick freezing and thawing, comes from one of America's oldest and most experienced operators. Sludge granulation by freezing, followed by water release by thawing, will have an appeal to operators who have observed the behavior of "frosted" sludge on sand beds. This article proves that the author's proboscis didn't get that way because its owner has been "sitting under the trees—just smelling the flowers".

"Determining Flows in Grid Systems"
Is not so simple. Therefore, this article, which analyses the controlling factors and explains the most satisfactory method of predicting available flows at various points on the grid system, is being presented in an effort to give a clearer conception of the problem and its reasonable solution.

"Experiences with Gas Purification"
Is one of a series of articles on sludge gas utilization in power development with gas engines. This article reveals much helpful information on gas scrubbing to protect the engines. Intended for this issue, circumstances necessitate holding it for July.

"Metering With Batteries vs. Compounds"
Constitutes a careful study and analysis, revealing the comparative accuracy and economy of the two methods.

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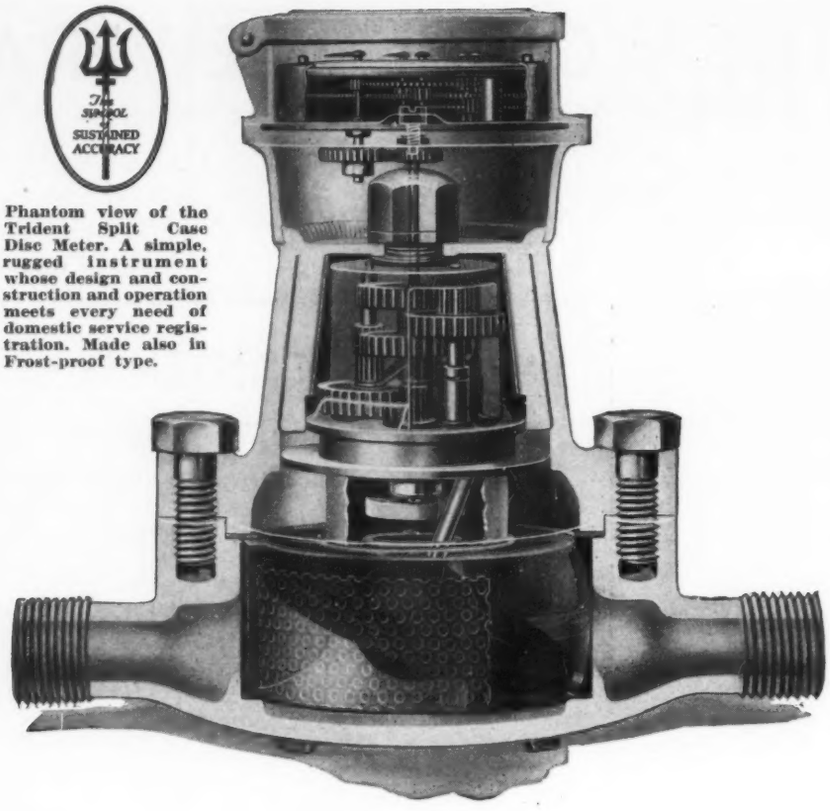

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WATER WORKS & SEWERAGE

VOL. 86, NO. 6 *A Gillette Publication* JUNE, 1939

RAW WATER PREPARATION FOR FILTRATION*

Experimental and Plant Scale Studies With a New Type of Mixing and Flocculating Device

By C. K. CALVERT
Chemical Engineer
Indianapolis Water Company
INDIANAPOLIS, INDIANA

NO single step in the production of a satisfactory filtered water is of more importance than that generally called clarification. It is important both from the sanitary and the economic standpoint that efficient coagulation and clarification be had.

Improperly or poorly prepared water permits bacteria and other impurities to pass through sand filters. In the algæ season good clarification is helpful because microscopic plants and animals, many of which produce tastes, are removed in the settling basins instead of on and within the filter bed. A filter supplied with poorly prepared water requires more frequent washing and must be completely renovated more often. From every standpoint it pays to prepare water carefully for filtration.

Principles of Clarification

Both chemical and physical processes are involved in the coagulation of silt and mud particles in water treatment.

First, the soluble coagulating chemical is precipitated in the water. The precipitation may be accomplished by the salts naturally in the water or by the addition of suitable chemicals such as lime or soda ash. If the precipitation takes place in a concentrated solution, the resultant particles are large and may include unprecipitated chemical which remains out of contact with the mud particles, is ineffective and is wasted. Such a situation can be avoided by suitable mixing and the control of strength of coagulant solution. Ideal mixing should result in the precipitation of the coagulant around or on every mud particle.

The Author

Second, the particles of precipitated coagulant are expected to collect the very finely divided mud particles into larger, heavier masses which will settle out rapidly. Efficient coagulation can be accomplished only by actual physical contact of the mud particles with the coagulant.

In a moving body of muddy water containing coagulating chemicals considerable time may be required to permit each mud particle to touch one of coagulant. In a relatively quiet body of water, a particle of coagulant will settle to the bottom, coming in contact with only such mud particles as may be in its narrow path. In either of these cases, good results may be obtained only by the use of an excessive amount of the coagulant. By supplying suitable mixing at the right time, coagulant is conserved, the size of structures may be reduced and uniform results are assured.

The size of the particles of flocculated material is unimportant if these be heavy enough to settle quickly. However, good floc will collect into larger particles if conditions are favorable.

In effective coagulation, after good initial stage mixing, the rate of agitation should be reduced gradually to one which will bring the particles together gently and prevent their settling to the bottom in the mixing unit. In fact, progressive decrease in rates of agitation seems to be of paramount importance. The primary object is to direct the course of the mud-laden floc gently to allow it to increase in size. After such treatment, the coagulant, with the mud it has collected, will settle quickly in a well designed basin.

Recent experiments show that in mechanical mixing and coagulation a variable speed drive is worth while, in addition to the variation in the rate of agitation from inlet to outlet. The alum required is reduced during low turbidity periods. At such times, higher rates of agitation are desirable because there are fewer particles of silt and coagulant per volume of water. Increased agitation makes more probable the collision of the two kinds of particles.

*A paper presented in a symposium on "Mixing, Coagulation and Flocculation," arranged by the Sanitation Group of the Am. Society of Mechanical Engineers in New York.

The Filter Plants of Indianapolis

The 12 mgd. Rapid Sand Plant is circled. The new flocculating units appear in the corner of the basins. Coagulation basins of the Slow Sand Plant in foreground (48-hr. detention) supply the slow fillers in center background.

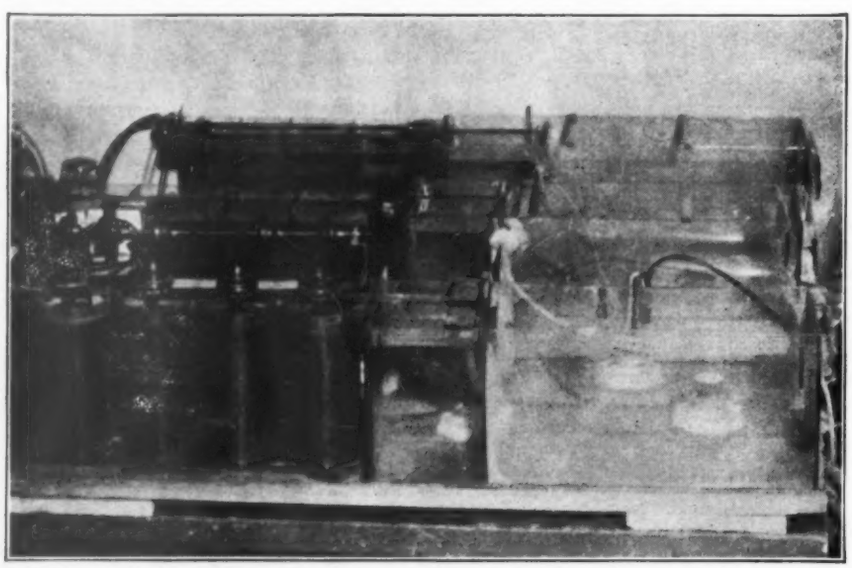
If too much coagulant is used, the resultant floc is only slightly laden with silt, it is very light and may be carried in too great amount onto the filters.

Historical

In 1921 Langelier[1] published an article on the Sacramento (California) plant in which the principle of rapid initial and slow final velocities in mixing was shown to bring about a saving in chemical and to shorten the mixing period.

In 1924 Hoover[2] reported improved coagulation and chemical saving by controlled mixing velocities of a higher order than was then customary.

Despite these publications very little was done until 1932, when Marsden Smith[3] published his mechanical flocculation experiences at Richmond, Va. Since then a number of mechanical mixing installations have been made, practically all of which have resulted in coagulant economy and improved clarification performance.



Transparent Laboratory Models

Operated paralleled studies of mixing and flocculating unit design, chemical economy and rapidity of clarification in minimum permissible retention periods.

Experiments at Indianapolis

To realize the desired end with Indianapolis conditions, experiments in mechanical mixing were conducted to follow the steps already outlined. Laboratory models were made of transparent material so that the movement of floc could be observed. The models were operated in parallel, fed with treated raw water from the same source and at the same rates of flow. A period of 30 minutes total mixing and flocculation time was allowed in each unit. In order to compare the results of flocculation, only a 30 minute holding capacity was provided in the sedimentation compartment.

New models are now in use which consist of a number of sections. They can be assembled to represent almost any prototype in different scale ratios. A paper will be published shortly on further model work.

After some weeks of observation, during which many changes were made as experience was gained with a considerable range of turbidities and with water of varying charac-

teristics, the over all best design was chosen for further study on large scale.

All of the test runs demonstrated that promiscuous return of old floc, as a feature of the flocculation process, defeated its own ends by promoting short circuiting which obviously reduces the effectiveness of the process. This requires that holding capacities be extended considerably. But the disadvantages of excessive short circuiting cannot be overcome entirely by increasing the flocculation time.

"Floctrol" Installation

The existing rapid filter plant of Indianapolis consisted of a two-part settling basin and six filters with a total rated capacity of 12 m.g.d. which could be raised to 15 m.g.d. in case of need. At the rated capacity, the settling basins provided a theoretical detention period of 6 hours. Coagulant was added 1500 ft. from the basin, the flow through a 42-in. conduit being relied upon to effect mixing with the water.

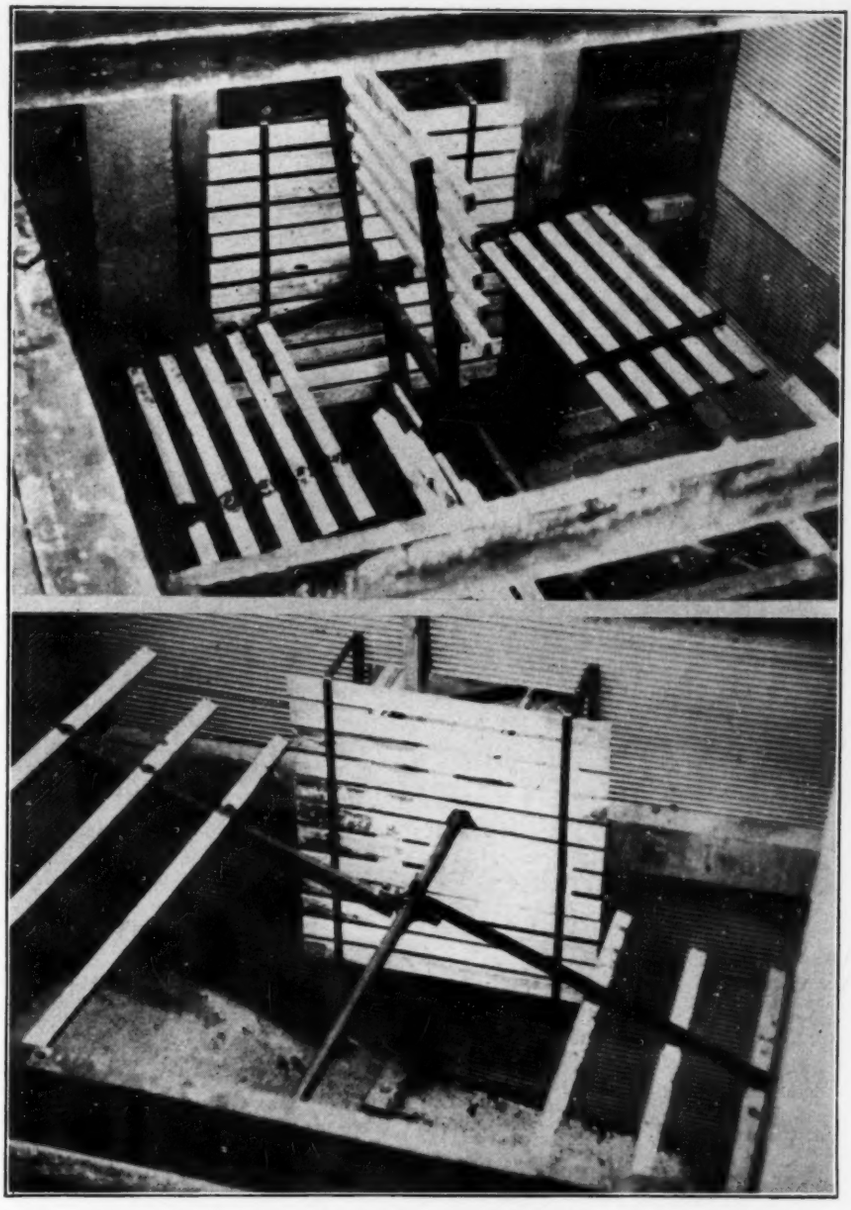
Three experimental units (named "Floctrols" by the manufacturer*), were built of temporary material in one end of one half of the settling basin. Thus the 6-hour settling period was reduced to 2 hours and 15 minutes.

These Floctrols consist of three separate channels 14 ft. in cross section and 75 ft. long. In each one, a shaft, with its axis parallel to the direction of flow, is fitted with angle iron arms drilled for bolts to secure paddle arms at as frequent intervals as desired.

Each Floctrol is divided into four compartments. The water in its passage, leaves each compartment through an orifice located symetrically around the central paddle wheel driving shaft. This arrangement of opening was found, by model operation, to prevent short circuiting better than any conventional baffling or other arrangement of openings. Openings at top and bottom or on opposite corners of successive walls permitted greater short circuiting. This was found, early in the operation of the models, to be objectionable.

Beyond the initial mixing, gradually reduced violence of agitation is accomplished through the coagulation stage by changing the position and number of the paddles attached to the supporting arms. Through the flocculation stage, the shaft speed is reduced and the rate of agitation further lessened by the adjustment of paddle arrangement similar to that used in the first compartments.

In order to be assured that the principles indicated in the laboratory models were correct, and to determine certain other arrangements, the initial installation was made as simple as possible. By continuous observation and test, additions and changes were made cautiously, one at a time, during the first few weeks of operation.



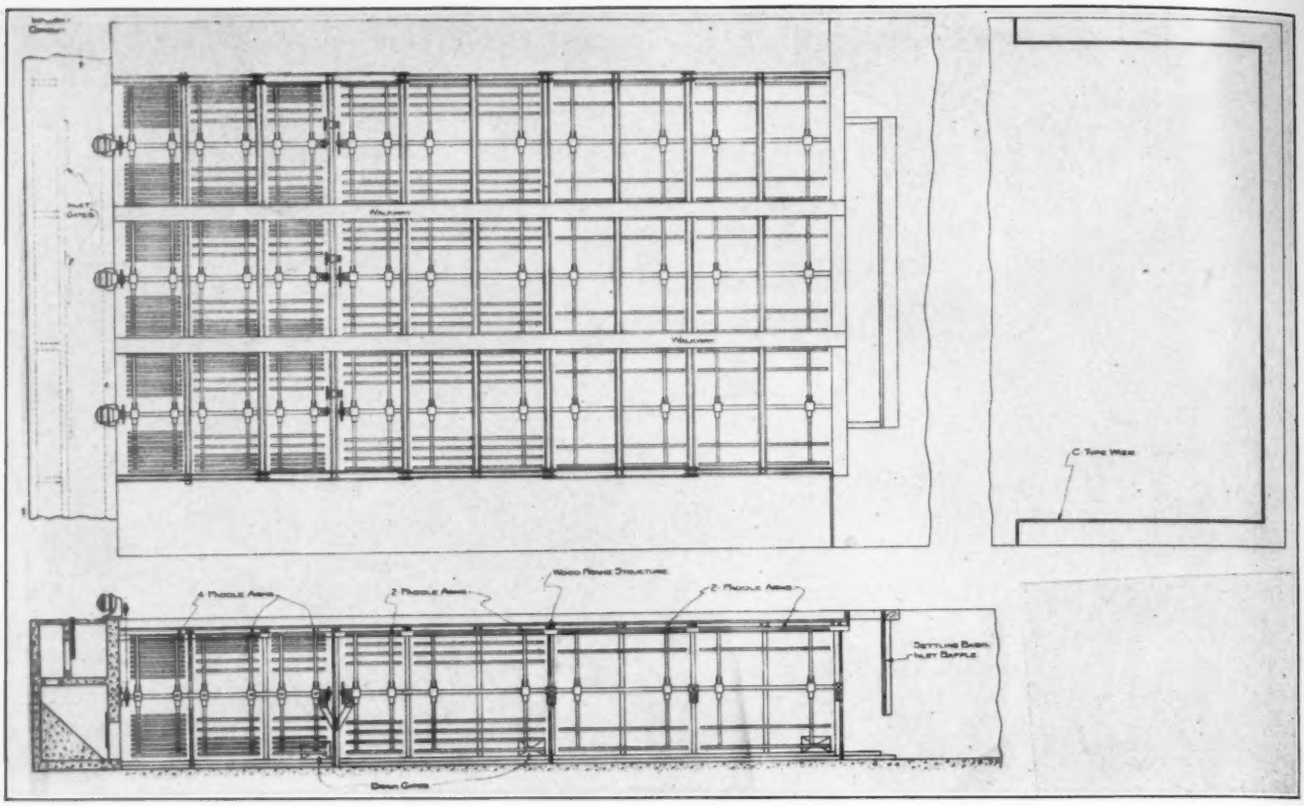
Two of the Four Compartments of the "Floctrol" Units Installed in the Plant
The upper picture is one of the rapid mix compartments from which the water flows to the slow mix (flocculating) compartment below. Note the four blade (20 slat) mechanism as against the more gentle 2 blade (6 slat) mechanism, both revolving on a common shaft. The center connecting parts around the shaft are visible behind the slat baffels.

Floctrol and Sedimentation Performance

When the best paddle arrangements and speeds had been determined, the settling basin operation was improved by suspending baffles down stream from the Floctrol outlets and by providing a long outlet weir along the sides and end of the clarification basin.

The nominal basin detention time is 2 hours and 15 minutes. One salt test, made when the basin had considerable sludge in it, showed the peak salt concentration at the outlet 46 minutes after it entered. Just after cleaning, the peak came

*The Jeffrey Mfg. Co., Columbus, Ohio.



The Three Jeffrey "Floctrol" Units as Installed at Indianapolis

Note the common shaft with variations in number of paddle blades and slats, providing rapid initial chemical distribution (mix) and diminishing rate through the 4 compartments.

through in 1 hour and 52 minutes. The two times are 34% and 84% of the nominal. This is good evidence of the need for keeping a settling basin free from sludge.

Each Floctrol was designed to treat 4 m.g.d. at nominal plant rating and 5 m.g.d. occasionally. Toward the end of the experimental period, the plant production was 10 m.g.d. This amount of water was put through two of the three Floctrols in order to learn what to expect during summer load when such rates might be demanded. The raw water turbidity was 35-40 p.p.m. Samples from the Floctrol outlets, allowed to stand 15 minutes, contained turbidities ranging from 0.3 p.p.m. to 1.0 p.p.m. The alum dosage was 75 lbs. per m.g. This rate of operation was continued for four days and the results warranted the conclusion that the Floctrols would take a 25% overload under summer conditions.

In July, it appeared that the summer water demand would not be excessive because of a liberal rainfall up to that time and, in order to further test the capacity of the Floctrols, one of them was taken out of service and the plant rate of 12 m.g.d. was put through the remaining two. Thus the Floctrols were given a 50% overload and the settling basin was operated at the same theoretical detention period of 2 hours and 15 minutes.

The turbidity at the start of this rate of treatment was 25-30 p.p.m. and settled water 1.0 to 2.0 p.p.m. The alum dosage was 100 lbs. per m.g. The operation, continued for 9 days, proved the assumptions made in the spring to be justified.

From October 7th to November 4th (29 days), the rapid sand plant was operated at 15 m.g.d. The turbidity of the raw water was quite low, averaging 13 p.p.m., but due to the season the plankton count was high, averaging 5300 individuals per ml., which required higher alum dosages than are required ordinarily. The alum use averaged 170 lbs. per m.g. The settled water turbidity averaged 1.4 p.p.m.

During this test period, the flocculation time was reduced to 30 minutes and the settling time to 1.8 hours, disregarding the space in the basin occupied by previously deposited sludge, the volume of which was unknown.

Short Circuiting

A dye test indicated a detention period of 25 minutes in the plant scale Floctrols, which have a calculated holding capacity equal to a 38-minute flow. This checks closely the results of a similar test made on the laboratory model.

Salt tests were made during normal operation which resulted in a Morrill[4] dispersion index of 2.7 to 2.8. The peak salt concentration appeared at the Floctrol outlets in 33 minutes after its addition at the inlet. This is 87% of the nominal time. The mean salt load came at 103% of nominal. (See Graph.)

Morrill[4] states that the mean time should be the same as the nominal and that the peak should be a little less in a well conducted salt test. These figures meet such requirements. Salt tests are good to show the effect of structural changes on short circuiting.

Bacterial Removal in Coagulation

From March to May, nine laboratory batch tests of coagulated water, settled 15 minutes, were plated for total bacterial count at 37°C. The turbidity of the raw water ranged from 10 p.p.m. to 800 p.p.m., averaging 225 p.p.m. The 37° bacteria in raw water ranged from 475 per ml. to 18000 per ml. and averaged 5500. The coagulated and settled water averaged 600 bacteria per ml., which represents a removal of 89% of the bacteria in the original water. The

settled water turbidity averaged 2.0 p.p.m. In all nine series, alum in excess of that required to produce a good filterable settled water, resulted in no further reductions in bacteria. On the contrary, on several occasions the counts increased with added amounts of alum beyond the optimum, as gauged by the residual turbidity.

Streeter's[5] results during the period 1926-1928 show that increasing rates of application of alum remove increasing numbers of bacteria. His settled water contained more turbidity than is now considered desirable and the bacterial reductions are somewhat lower. Our meager work corroborates the results he obtained and it is unnecessary to elaborate them, especially since prechlorination is now practiced so generally and the role of the coagulant in producing a safe water is of diminishing import.

Streeter's conclusion that two stage coagulation should not prove profitable is borne out in our own experience. Repeatedly, especially with water of higher turbidity, it has been found that substantially the same application of alum is required by water after coagulation and 24 hours quiescence as was required originally. And, too, poorer sedimentation results, because of the light gravity of the mud particles remaining in suspension.

A good filterable water is one which has a *flocculent* turbidity of 1.5 to 2.0 p.p.m. In plants operating with settled water turbidities of from 10 to 30 p.p.m., added alum will result in greater bacterial removal as well as improved quality in other respects.

Bacterial removal in sedimentation may not be necessary but is certainly not objectionable. Spore formers will be removed which chlorination will not kill. If mechanical flocculation results in better removal of mud, it is not strange that it will be more effective in bacterial removal also.

Typical of many batch tests made is the following. The raw water turbidity was 1100 p.p.m. and a treatment of 1200 lbs. of alum per m.g. was applied and mixed. Half the sample stood for 50 minutes and the supernatant had a turbidity of 110 p.p.m. The sample which was given the standard stirring, after only 15 minutes sedimentation had a turbidity of 1.5 p.p.m.

Economy in Chemical Use

On the same site at Indianapolis, raw water from a common source is treated in two separate plants. The water filtered by the older plant is prepared by coagulation, mixed by flowing through some 1500 ft. of conduit and settled in a basin providing 48 hours detention. The water filtered by the newer plant is prepared by flocculation and settling as described previously.

Before installing Floctrols, the use of alum in the new plant was higher than in the old plant. After their installation, the use of alum has been lower in the new plant. On the basis of the relationship between the alum use in the two plants during the previous ten years, the saving in alum in the new plant in 1938 amounted to 46% or 147 lbs. per m.g. of water treated.

It is not possible to compare one month or even one year with another because the character of the raw water is not constant. The coagulant requirement is not constant for similar turbidities even over comparatively short periods. In the period from the middle of February to the first of April, 1938, a 100 lb. alum rate was used on turbidities ranging from 10 p.p.m. to 75 p.p.m. and a 325 lb. rate on turbidities ranging from about 100 p.p.m. to 675 p.p.m.

In 1938 the highest plankton counts of which we have record

TABLE 1

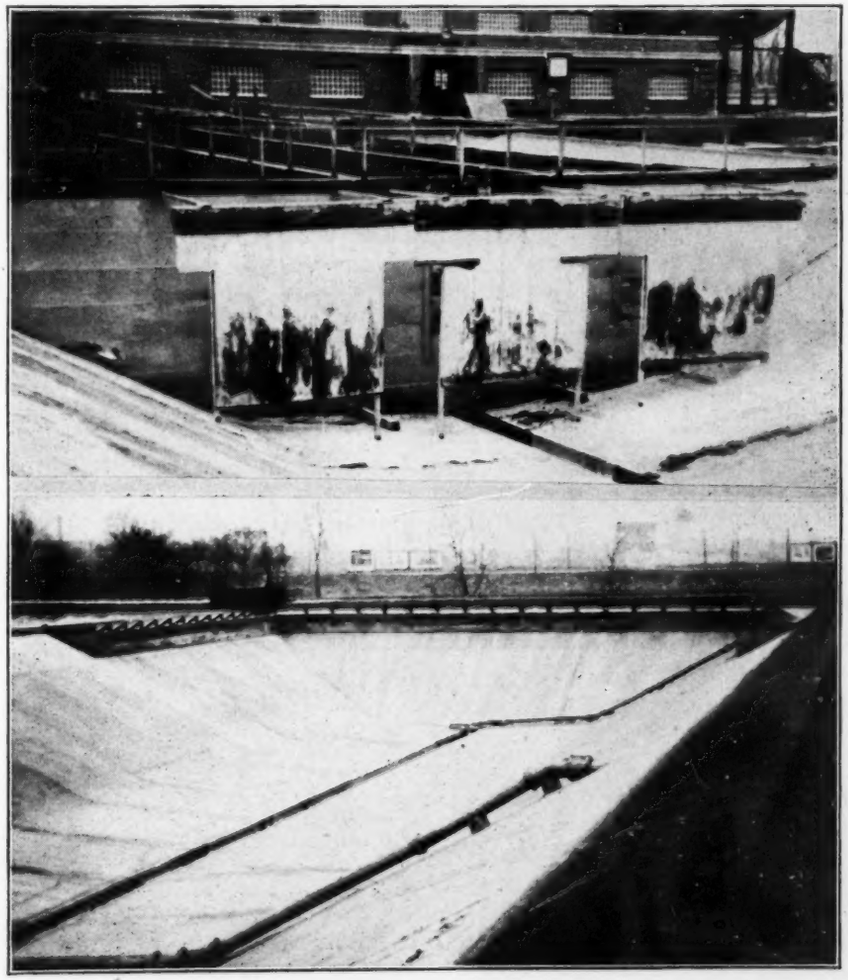
Annual Coagulant Summary

(Pounds per Million Gallons)

Year	*Old Plant*	*New Plant*
1928	204	201
1929	203	224
1930	153	164
1931	146	193
1932	230	249
1933	260	370
1934	284	418
1935	236	325
1936	244	315
1937	227	250
10-Year Average	218	270[1]
1938	256	168[2]

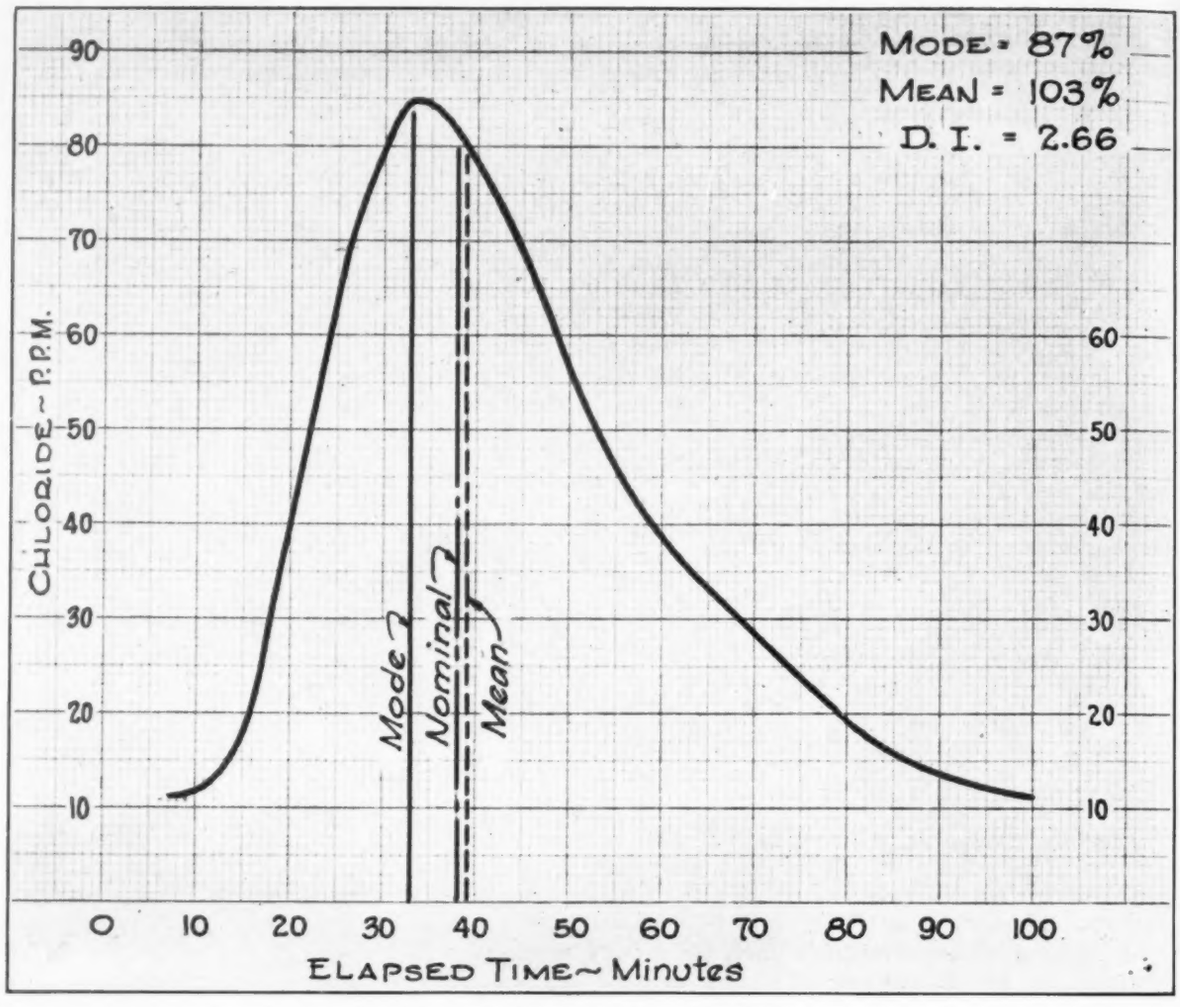
[1] Without mechanical flocculation equipment. Coagulation basin detension period = 6 hrs.

[2] With mechanical "Floctrol" units in operation. Coagulation basin detention period = 2¼ hrs.



Influent and Effluent Ends of Basin

Note hanging baffels for stilling flows from flocculating units into the basin. Note improved even take-off of effluent, around three sides of outlet end of basin.



Plot of Salt Test—"Floctrol" No. 2

In 33 minutes the salt peak reached the effluent end; in 39 min. the mean concentration had passed. Compared against the calculated theoretical period of 38 minutes, displacement efficiency lies between 87% and 103% and indicates continuity of efficient displacement.

were found in the raw water. This is believed to be the reason for a greater required coagulant use on the old plant for that year than has been recorded in eight of the previous ten years. Disregarding the relation between the use of alum on the two plants, the alum use per m.g. on the new plant in 1938 is 37% less than its average for the previous ten years. (See Table I.)

By which ever method it is calculated, the alum saving in 1938 represents more than half the cost of the Floctrol installation, which includes the structural additions required as well as the mechanisms in place.

Operating Results and Observations

In 1938, the average filter run was longer than in previous years. More water was filtered, which is due mostly to the chemical economy possible with Floctrols. The washwater used was 1.54% and the average for the previous ten years is 1.32%. At least part of this increase is due to other experimental work done in 1938.

The turbidity of settled water may be taken as a good measure of the excellence of operation, especially when it is remembered that, formerly, the settling basin detention period was 6 hours and after Floctrol installation it is 2 hours and 15 minutes. The average turbidity of settled water for the life of the new plant was 3.6 p.p.m. The average for 1938, when Floctrols were in use, was 2.6 p.p.m. The difference is small.

Cost of Floctrol Operation

The cost of Floctrol operation at Indianapolis, above and over the usual settling basin cost, consists of power, lubricants and replacement of worn parts.

Each unit is driven by a 1.5 h.p. motor through a Universal speed reducer. The power input is 1.70 amperes which is just 1 h.p. This is about 1 k.w.h., allowing for transformer and line losses. Oil changes in the speed reducers cost $12.00 per year. Only one other bearing, the idler pulley bearing, requires lubrication. Perhaps that may cost $1.00 per year.

The cost of operation of Floctrol mechanisms was at the rate of 9.2 cents per m.g. of water actually treated in 1938. The average rate of operation was 85% of the nominal or 68% of the maximum. It could have handled considerably more water with no increase in the cost of any item.

It is not possible to estimate the cost of parts replacements. From observations, however, it is believed that new parts will be required so infrequently as to warrant their inclusion in interest and depreciation rather than operation.

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FLOCCULATION IN THEORY AND PRACTICE*

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The Dorr Company, Inc.
NEW YORK CITY

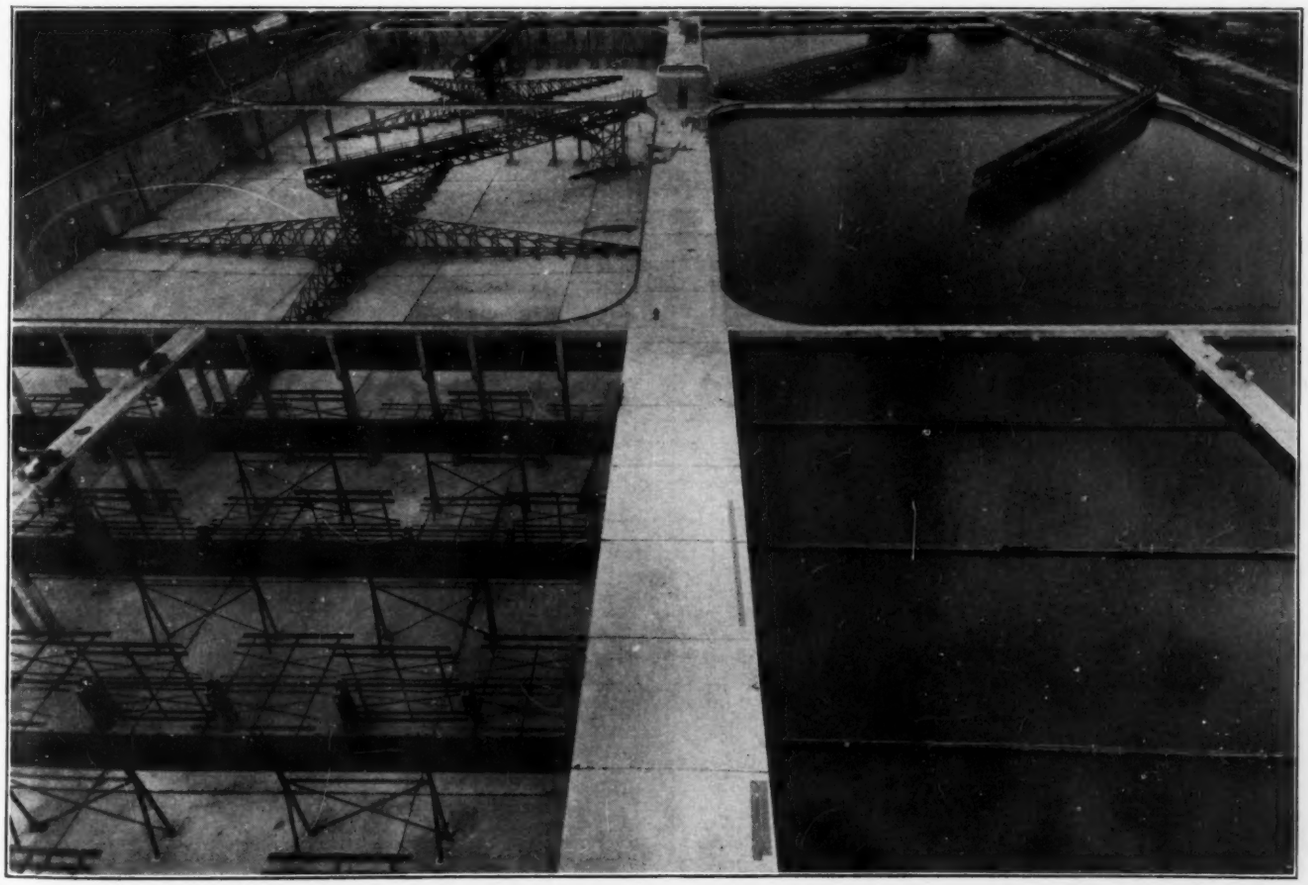
DURING the last part of the nineteenth century and the first quarter of the twentieth century, a very large number of investigators published information derived from work dealing with coagulation and related phenomena, a large part of it resulting from what may be called fundamental studies in colloidal chemistry. The last twenty year period, however, has seen the growth of a relatively extensive literature dealing with the practical application of flocculation phenomena in a variety of industries. Papers covering investigations on water purification have probably outnumbered those in other fields. Out of some six hundred collected references on the subject, by the end of 1930, over five hundred of them are classified as fundamental studies while less than one hundred may be classed as having industrial application as a primary objective.

The Author

As is often the case, in spite of the preponderance of publications of a fundamental nature, practical application of the phenomena of flocculation may be credited with creating the first interest in the subject.

Sidell[1] in 1838 conducted one of the first relatively systematic studies on the effect of various salts on aqueous suspensions. This work was directly due to the investigation of problems relating to deepening the channel at the mouth of the Mississippi River. The use of electrolytes in the flocculation of slimes may be considered one of the earliest applications of the process of coagulation in industry, this application having been preceded only by the clarification of turbid water. Schurer[2] made a study of the effect of electrolytes on slimes as early as 1851, but until Graham published his findings concerning the nature of colloids, and by so doing created a keener interest in the properties of these "pseudo solutions," little attention was paid to any previous studies. Skey[3] in 1868 published a study of the coagulation and precipitation of clay by

*A paper presented in a symposium on "Mixing, Coagulation and Flocculation," arranged by the Sanitation Group of the Am. Soc. of Mechanical Engineers in New York City.

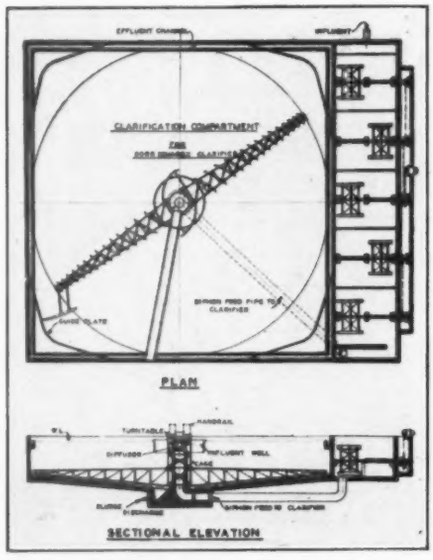


Cincinnati's 200 M.G.D. Filter Plant
Dorrco Flocculators and Clarifiers In Same Basin

neutral salts. Sewage coagulation was given little or no attention until after the first decade of the twentieth century. Treatment of trade wastes developed more or less concurrently with sewage treatment.

In industrial applications of flocculation phenomena, the procedure no doubt has often been that of finding a coagulant which was satisfactory for the purpose desired, and then stopping the investigation at this point. In many cases, further studies would probably have meant greater efficiency and savings in operating costs.

By a more comprehensive treatment of published literature it would be seen that the trends in the researches devoted to the subject of coagulation have been toward fundamental treatises with apparently little or no consideration as to the practical significance of some of the ideas and theories advanced. The so-called practical man tends to avoid too much theory and the theoretical man often fails to emphasize the practical value of the theory with which he is so familiar.



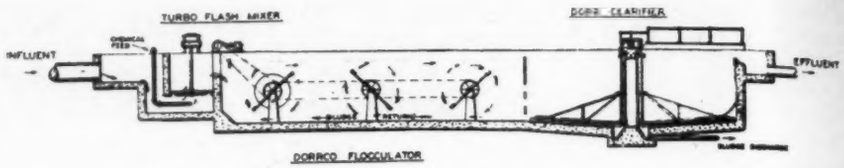
Combination Flocculator—Clarifier Unit

In this design the flocculated water or sewage receives clarification by radial outflow from the center-fed clarifier.

Objectives of Coagulation

During recent years a great deal more attention has been devoted to the practical phases of coagulation and the resultant increased sedimentation rates and clarifying ability. That such is the case is attested by the large number of patents issued covering flocculants, flocculating processes and flocculating equipment. In many such cases, claims are rather fantastic and, having no sound basis for existing, the processes are impractical. A few of them are worth while contributions to the advancement of the art.

There still seems to be a lack of full appreciation of the extent to which a knowledge of the theoretical principles involved may contribute to the efficiency of the process. Also, there is still quite a wide gap between basic theory and the practice to which the theory is frequently applied.



Three Stages of Treatment in One Unit

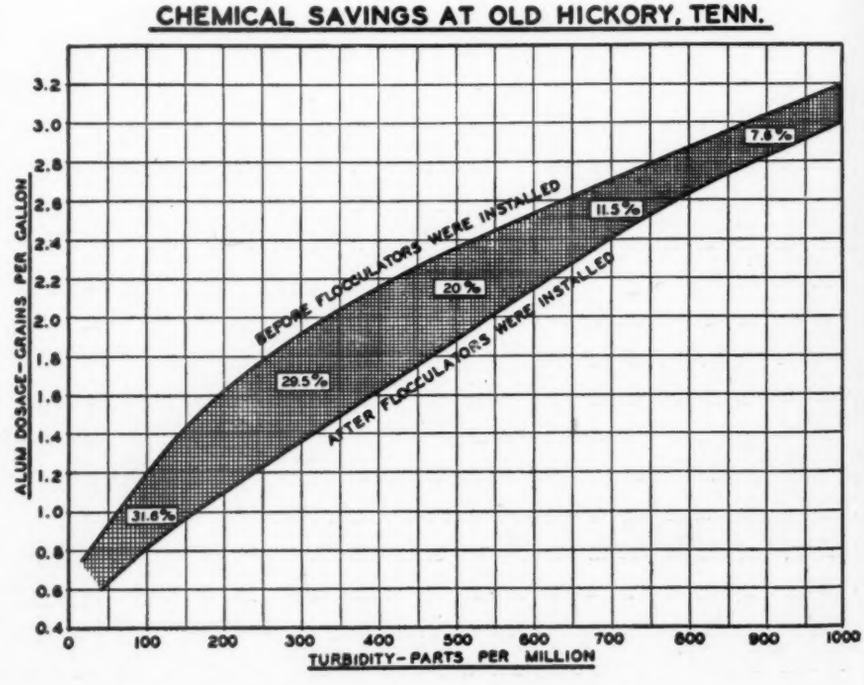
Chemical feed line terminates below the high speed flash mixer, which delivers to the slow speed flocculators. The flocced water passes through the clarifier zone to the filters. Note the directional rotation of the flocculator paddles, producing floc lifting and barrel-roll agglomeration, and back-sweep of sludge particles.

Mechanics of Flocculation

Flocculation may be defined as a "grouping together into small lumps." The essential feature of flocculation is the building up of a uniformly heavy tenacious floc structure which entraps the fine suspended and pseudo-colloidal solids and carries them down rapidly in the sedimentation step. Proper flocculation provides gentle mixing so as to cause the flocs to sweep through the water and also provide for re-circulation of well-formed flocs through the flocculating zone.

Flocculation, by means of which non-settleable particles suspended in a dispersed state in a liquid are caused to group themselves into aggregates of settleable solids, is influenced by two main factors. First, collision, and second, adhesion. The first is dependent entirely upon physical forces. It may be safely assumed that the second factor is controlled by chemical or electronic forces.

Dispersed particles in aqueous suspension generally carry either negative or positive charges of electricity. Flocculation of such dispersed particles involves the neutralization of electric charges. In addition to the charges, each particle is surrounded by a sphere of attraction. As long as the particles are similarly charged they will not flocculate, although their momentum may be such that they are thrown within the sphere of attraction even to the point of actual collision. Certain weakly charged particles may be attracted strongly enough to flocculate into aggregates of two or more, providing they are caused to collide. The probability of adhesion, then, is dependent upon the extent to which the charged particles are neutralized by the addition of certain chemicals or



Chemical Savings Charted for the Du Pont Filtration Plant at Old Hickory, Tenn. Combination Unit of Economical Construction

electrolytes. With complete neutralization or the adjustment of pH to the iso-electric point, the probability of an adhesion for each collision is one. This condition constitutes the zone of rapid coagulation. Its practical importance lies in the fact that this point should always be approached but never exceeded for any disperse system.

The Work of Mechanical Flocculation

Assuming that a disperse of fine particles in water is conditioned so that each collision results in an adhesion, the rate and extent of flocculation are then dependent only upon the probability of collision. It is the function of the gentle agitation of flocculators to exercise control over this factor in coagulation and flocculation practice. Mechanical flocculators provide an outside energy source to supplement and assist in the probability of collision, through gentle agitation to greatly increase this probability, particularly for those particles and aggregates exhibiting little or no Brownian movement. Mechanical flocculation also changes the random motion of each suspended solid into a controlled type of motion more nearly that which will promote the maximum number of collisions in a given time. This condition should not, of course, be brought about in such a way that particles already coagulated are redispersed. In many problems, once a floc has been formed and broken, it will not re-form in the system.

NEW BRUNSWICK OPERATING DATA*

	Before Installation Dorrco Flocculators	After Installation Dorrco Flocculators
Average Flow—M.G.D.	5.8	6.5
Turbidity — P.P.M.	13	14
Color — P.P.M.	54	46
Alkalinity — P.P.M.	3.72	3.90
Alum Consumption—lbs. M.G.	147	107
Alum Saving — per cent	—	27.2
Alum Saving — per yr.	—	47.3 tons
Lime Consumption—lbs. M.G.	125	111
Lime Saving — per cent	—	11.2
Lime Saving — per yr.	—	16.5 tons
Wash Water —M.G. per yr.	46.5	39.7
Wash Water Saving—per M.G.—per cent	—	27.2

*Courtesy Mr. Asher Atkinson, City Engineer, New Brunswick, N. J.

Operating Data for the New Brunswick, N. J., Filtration Plant
Revealing economic advantages of Flocculators for colored waters.

The following table lists results of work done by Dr. E. J. Roberts and G. M. Darby in 1933 with a mechanical flocculator.

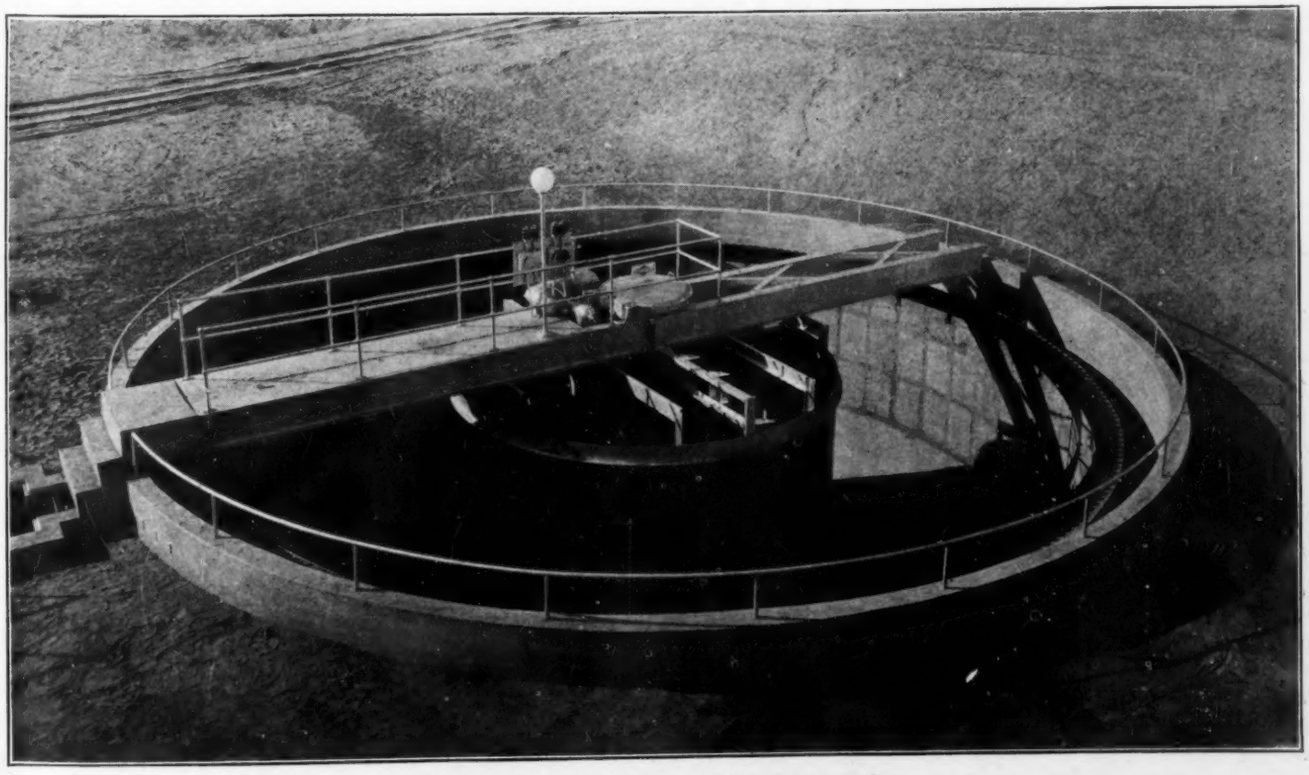
TABLE 1

Relation between paddle speed and time of flocculation:

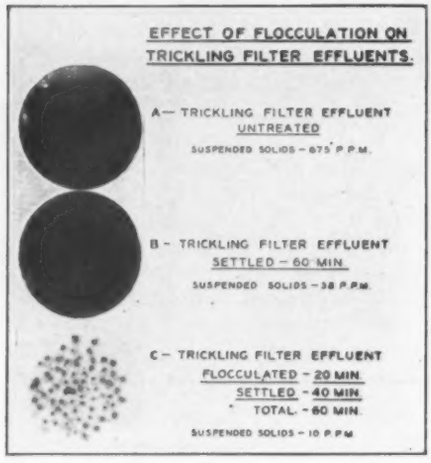
Test No.	*Paddles*	*Time in Minutes*	*P.P.M. Turbidity after 22 minutes settling*
1	30	5.6	12
2	24	7.0	5
3	20	8.4	4
4	15	11.2	6
5	10	16.8	12

Time and speed combinations to give 168 total revolutions gave about the same results as 24 to 15 r.p.m. At 30 r.p.m. and 10 r.p.m. the result was poor, the time at 30 r.p.m. being too short for floc formation, and the speed at 10 r.p.m. permitting the flocs to settle out too much for best results.

The more rapidly a mechanical flocculator can operate (in r.p.m.), the more efficient the results obtained, assuming, of course, the speed of the flocculator mechanism is below the velocity at which the floc will be shredded. It naturally follows that the greater the r.p.m. of the paddle, the more chances for collision between the particles to be



Combination Unit of Economical Construction
This unit with Flocculator at center of Dorrco Clarifier serves for chemical precipitation of sewage at new plant of Ypsilanti, Mich.


EFFECT OF FLOCCULATION ON TRICKLING FILTER EFFLUENTS.
A— TRICKLING FILTER EFFLUENT
UNTREATED
SUSPENDED SOLIDS – 675 P.P.M.
B – TRICKLING FILTER EFFLUENT
SETTLED – 60 MIN.
SUSPENDED SOLIDS – 38 P.P.M.
C – TRICKLING FILTER EFFLUENT
FLOCCULATED – 20 MIN.
SETTLED – 40 MIN.
TOTAL – 60 MIN.
SUSPENDED SOLIDS – 10 P.P.M.

These Filter Discs Reveal the Effectiveness of Coagulation and Flocculation of Sprinkling Filter Effluents Subjected to 40-Minute Clarification

flocculated. It is usually accepted that definite assistance results in flocculation if well-formed flocs can be present at the point where unflocculated water enters the flocculation chamber. This well-formed material acts as nuclei for assisting in the flocculation of incoming finely divided particles.

A rotary or barrel-like roll should be imparted to the liquid during flocculation. For best overall results it is essential to obtain a high gravity, tightly knit floc to insure rapid settling after leaving the flocculating zone. A large floc will not necessarily mean good flocculation, as the large flocs may be feathery in structure and slow settling. Where solids have been properly flocculated, almost all of the resulting particles will settle out at practically the same point in the settling basin.

Time For Flocculation

The duration of the flocculation period depends on the treatment, but broad requirements for best results are as follows:

	minutes
1. Sewage Flocculation	30 to 45
2. Water coagulation with alum, ferric chloride, etc.	30 to 60
3. For water softening, using lime	60 to 90

Many operating plants do not have these detention periods, particularly those coagulating water, but it has been repeatedly demonstrated that the longer periods are better from every standpoint. This fact is being reflected more and more in recent design.

Main Advantages of Proper Flocculation

The main advantages of proper flocculation are as follows:

1. Improved quality of settled effluent because of effective coagulation.

2. Where chemicals are used, proper flocculation will generally provide a substantial saving.

3. Where filters are used, following sedimentation, reduction in cost of plant operation as less frequent washing of filters is required.

4. Increased sedimentation and filtration rates, and consequently plant capacity.

5. Lower power and operating cost.

6. General overall improvement in plant operation.

7. Consistent results possible in spite of fluctuation in character of raw feed.

SEWAGE DISPOSAL PLANT – DENVER, COLORADO
OPERATION and ANALYTICAL RESULTS
5 months — 1938

MO.	AVGE. FLOW MGD	SUSPENDED SOLIDS RAW	SETT.	FILT.	OVERALL PCT. RED. SETT.	FILT.	B.O.D. RAW	SETT.	FILT.	OVERALL PCT. RED. SETT.	FILT.	1,000 Bacteria -Total Count 37° RAW	SETT.	FILT.	OVERALL PCT. RED. SETT.	FILT.
Aug.	39.7	148	54	29	63	80	122	63	43	48	65	8400	5550	5000	34	41
Sept.	38.9	157	47	30	70	81	117	65	54	44	54	4400	3000	2600	18	41
Oct.	37.8	180	59	35	67	82	156	94	54	40	65	2500	2250	1350	10	46
Nov.	37.7	178	64	37	63	79	172	98	70	43	59	1740	1500	1200	14	31
Dec.	38.9	194	82	40	58	79	182	109	83	40	54	780	478	373	37	50
AVERAGE	37.8	170	57	34	66	80	150	86	61	43	59	3640	2975	2100	25	41

Operating Data From the Sewage Treatment Works of Denver, Colorado
Mechanical Flocculation and Magnetite Filters without chemicals.

1. W. H. Sidell, Report on Hydraulics and Physics of the Mississippi River. Appendix, page 500, 1838.

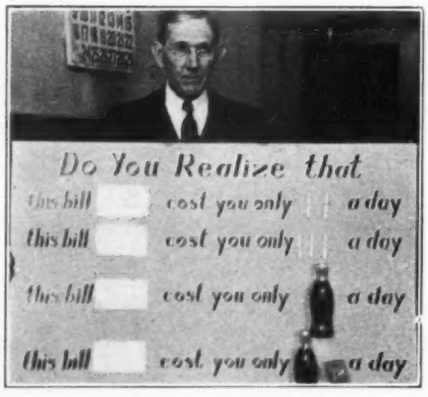
2. T. Schurer, Poggandorf and Annalen—Chem. and Physics—(1851).

3. W. Skey, Chem. News, April 3, 1868.

"PUBLIC RELATIONS" (An Idea from Spartanburg)

Twenty-one years ago Ye Ed went down to Spartanburg, S. C., to take on his first job of operating a filter plant. In those days "Public Relations" had practically no status in municipal operation, and we probably thought that the "relations" part had something to do with "kinfolks."

Just recently, (twenty-one years later) Ye Ed went back to Spartanburg, there to find two of the faithfuls of 1918 still carrying on, but in a Department and plant little resembling that of 1920 which "Bob" Simms found when he took over as superintendent. Also, "Public Relations" had come in for its share of attention in the interim and few


Do You Realize that
this bill cost you only a day
this bill cost you only a day
this bill cost you only a day
this bill cost you only a day

Water Departments now enjoy a higher civic recognition.

The window exhibit (pictured above) is an interesting bit of goodwill propaganda. Of principal interest is the fact that both the idea and the execution are products of the office staff of the Department.

We dare say that Spartans hardly realized that the minimum water user gets all the water required for the home at the price of only two cigarettes a day; that the more extravagant users get their many gallons of water at the cost of a bottle of Coco-Cola per day; and the most extravagant domestic user gets his daily requirements for the cost of a "Coke" and a package of cheese-wafers.

Behind the placard stands Superintendent Simms, who we asked to remove the exhibit temporarily for photographing. He thought the producing staff members should have been snapped instead, but it was Sunday and they were not available. Such consideration by the big boss illustrates that good public relations (like charity) beings at home.

FLOCCULATORS AND COAGULATION*

By C. J. VELZ
Professor of Sanitary Engineering
Manhattan College
NEW YORK

THE process of clarification of liquids by coagulation is a complex phenomenon. Under apparently similar conditions, results observed at one installation often are the opposite of those at other locations. Failing to understand and explain discrepancies, we frequently damn or unduly praise a specific make of equipment or a particular chemical coagulant, when, in reality, other factors are responsible for the variation in results.

Fundamental Influences

But before discussing operating practice and results, let us consider fundamental influences for a moment. Clarification by coagulation is believed to be an electro-chemical process, wherein the charges on the introduced floc react with the opposite charges on the colloidal matter in the liquor, thereby effecting concommitant precipitation. There is accumulating evidence to support this theory and to discount the former concepts of simple chemical or merely mechanical phenomena. In this reaction, concentration and activity of ions are of more importance than mere quantity of salts present. Instruments of observation capable of reflecting variation in the dielectric constants: ionization; hydrolysis; ion sorption . . . are the tools which will assist, perhaps, in prying into the darkness.

Three important factors influencing the reactions are: colloids in the liquor; pH; and temperature. Of colloids we know little beyond their possession of positive or negative charges; we have been doing a good deal with pH; but temperature has been too much neglected. In my opinion, temperature exerts a powerful influence. When minimum practical operating dosages of chemicals are employed, colloidal content, pH and temperature play important roles, for it is at the threshold of minimum dosage that results are subject to strong influence by these factors. Of course, one way to overcome influences is to use large dosages of coagulant, and one reason why results of research are not more closely correlated with observations in practical operation is that in the theoretical investigation dosages substantially above operating quantities are frequently employed. However, economical operation dictates use of minimum quantity of chemical.

For a given colloidal load, pH and temperature (independently and also

*A discussion presented in a symposium on "Mixing, Coagulation and Flocculation," arranged by the Sanitation Group of the Am. Soc. of Mechanical Engineers, New York City.

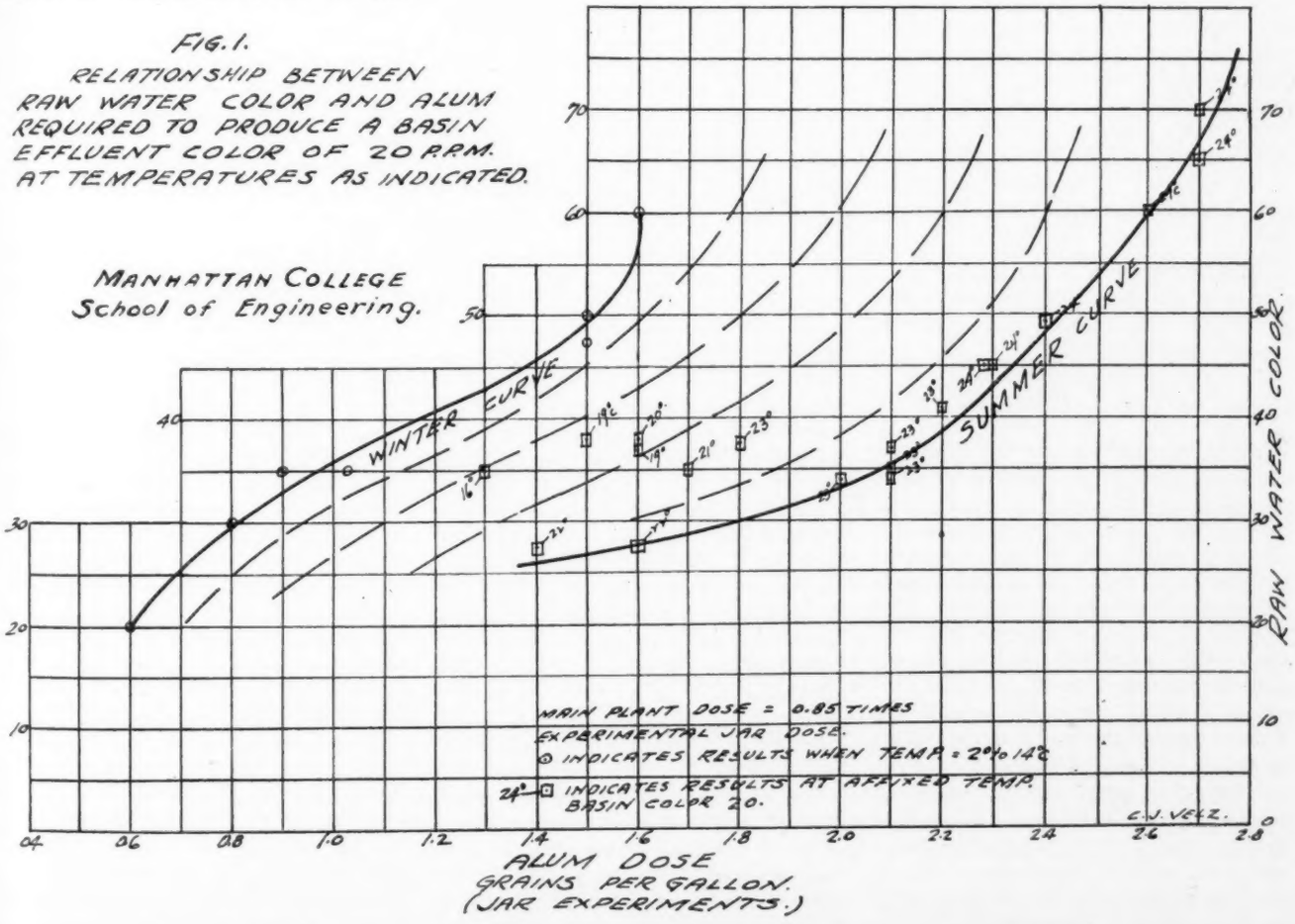


FIG. 1.
RELATIONSHIP BETWEEN RAW WATER COLOR AND ALUM REQUIRED TO PRODUCE A BASIN EFFLUENT COLOR OF 20 P.P.M. AT TEMPERATURES AS INDICATED.
MANHATTAN COLLEGE
School of Engineering.
WINTER CURVE
SUMMER CURVE
MAIN PLANT DOSE = 0.85 TIMES EXPERIMENTAL JAR DOSE.
INDICATES RESULTS WHEN TEMP = 2°% 14°C
INDICATES RESULTS AT AFFIXED TEMP.
BASIN COLOR 20.
C.J. VELZ.
RAW WATER COLOR
ALUM DOSE
GRAINS PER GALLON.
(JAR EXPERIMENTS.)

Fig. 1—The Influence of Temperature on Alum Requirement for Given Color Removal
Summer vs. Winter Operation.

in combination) are the primary factors which determine the minimum dosage necessary to produce a desired result. All operators and investigators have an appreciation of the influence of pH. However, from my investigations and analysis of extended records of operation, I have found temperature to be of primary importance in affecting results. Again I wish to emphasize that its importance is evident only when dosage of coagulant is cut to the minimum. That is to say—when the plant is being operated on a fine economic balance in respect to chemical costs.

The accompanying graphs illustrate clearly the effect of these three factors. In these studies colloidal content and efficiency of treatment have been evaluated in terms of color intensity, a sensitive index.

What the Graphs Reveal

Figure 1 shows the relationship between raw water color and alum dosage necessary to produce a sedimentation basin effluent of 20 ppm. The curve designated "Winter Curve" indicates the alum required during periods when water temperature ranged from 20° to 14°C. and the "Summer Curve" refers to alum requirements when water temperature ranged from 22° to 24°C. For example, a raw water of 35 ppm. color during winter requires about 1.0 grain per gallon of alum, whereas in summer it requires about 2.1 grains to achieve the same color removal.

In order to verify the influence of temperature and to eliminate the possibility that coinciding seasonal factors were responsible for the necessary increase in alum dosage, tests were devised whereby summer waters were artificially cooled to winter temperature and the effect on alum dosage determined. Figure 2 shows a typical result of such tests. The solid curve indicates relationship between alum dosage and temperature changes which took place naturally through the seasons. The dotted curve indicates results with the artificially cooled summer waters. The two curves closely parallel, indicating that temperature was the dominating factor in coagulation economy in color removal.

The influence of pH and temperature upon efficiency of color removal is indicated in Figure 3. At summer temperature the optimum pH is lower and confined to a critical range in the vicinity of pH 5.4. At winter temperature pH is not so important, as the optimum varies over a wider

FIG. 2

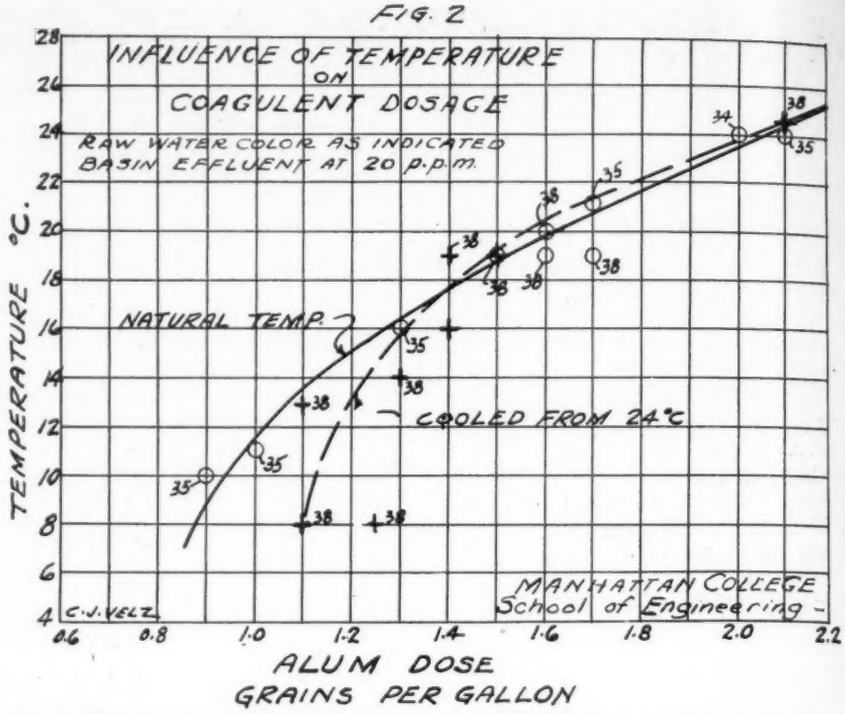

INFLUENCE OF TEMPERATURE ON COAGULENT DOSAGE
RAW WATER COLOR AS INDICATED BASIN EFFLUENT AT 20 p.p.m.
NATURAL TEMP.
COOLED FROM 24°C
TEMPERATURE °C.
ALUM DOSE GRAINS PER GALLON
MANHATTAN COLLEGE School of Engineering
C.J. VELZ

Fig. 2—Temperature Influence Proved by Coagulating Artificially Chilled Samples and Non-Cooled Samples for Comparison.

range and is much higher. From the curves it is apparent that at summer temperature pH must be reduced to 5.6 to produce a basin effluent of 10 ppm. with 1.5 grains per gallon. At winter temperature, 10°C., the same removal of color can be obtained at pH 6.7. Furthermore, at pH 6.7 and summer temperature 1.5 grains per gallon is ineffective in removal of color.

A study of operating records of the main plant (35 MGD), by standard statistical methods, again indicated the dominating influence of temperature. The coefficient of correlation between temperature and plant alum dosage was 0.75 as compared with coefficients of correlation of pH and alum dosage of 0.29 and raw water color and alum dosage of 0.42. With coefficient of 1.0 indicating complete and perfect relationship, the high order of the coefficient involving temperature unquestionably shows the importance of the latter in influencing chemical requirements for effective color removal.

In Operation What Are We Trying to Do?

In operation what are we trying to do, and how are our efforts consistent with the fundamental theories of clarification? Flocculation, as it is practiced today, comprises essentially two functions, mixing and agglomerating; and these two functions are performed simultaneously in one operation. By mixing we mean uniform distribution of coagulant to successive units of liquor and maintenance of this even distribution during the time required for formation of floc nuclei. Agglomeration is the process of building the floc nuclei into larger floc clusters. Prior to agglomeration, regardless of the length of mix, little or no clarification will take place, and after complete and uniform agglomeration, (and I underline *uniform*) no further improvement to subsequent clarification takes place. We know, also, that if liquor passes to the sedimentation unit before the time necessary to develop floc nuclei, the nuclei form in the sedimentation basin as pin point floc which not only does not clarify the liquor, but actually remains in suspension to give troubles at the filters. Successful operation, then, is dependent upon uniform mixing for the minimum time to develop all floc nuclei, and secondly, upon subsequent uniform and complete agglomeration.

What of Modern Floc Building?

Prior to the advent of mechanical and air flocculators, the coagulant was added and after a short mix the liquor was passed into a large basin wherein floc nuclei formed irregularly and agglomeration took place at random and to varying degrees, with some floc settling and much passing on to the filters. In sewage treatment the inefficiency of

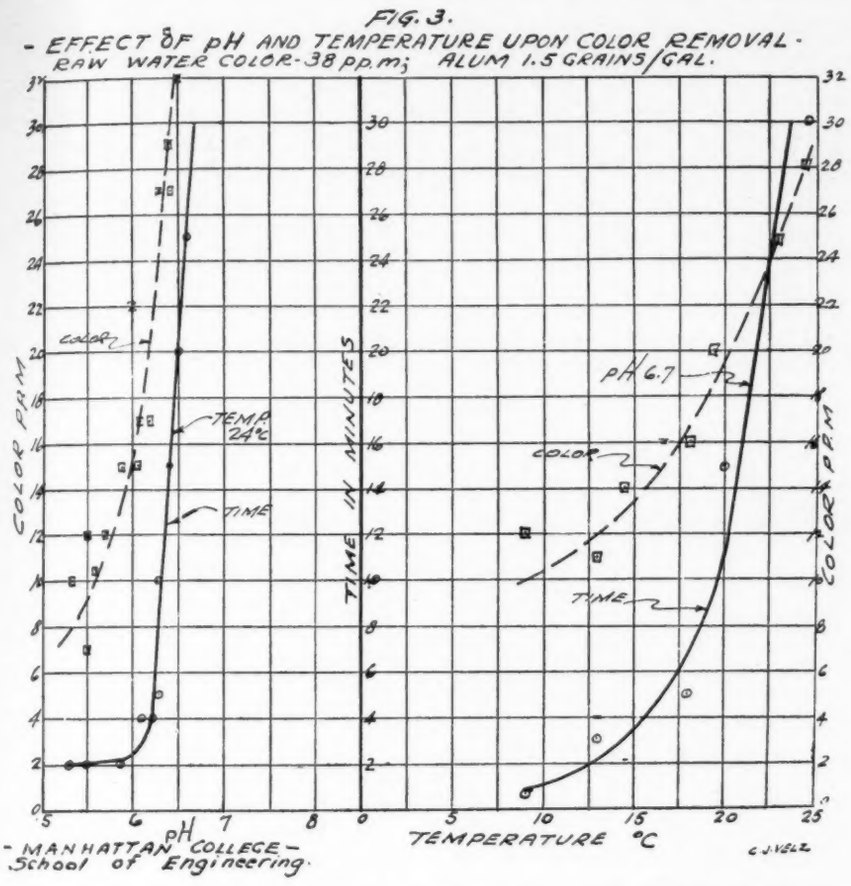


Fig. 3—The Influence of Temperature on the Critical Zone of pH for Effective Coagulation

this old method placed chemical precipitation in disrepute. In water purification the filters took most of the load. With the advent of flocculators we have changed this system to the extent that the degree of agitation in mixing is reduced to a careful, gentle motion so that floc nuclei which gradually agglomerate will not break up, and yet sufficiently vigorous to sweep the floc around through the water. This change in operation is an improvement over old methods only to the extent to which it can advance uniform formation of floc nuclei and provide more complete and uniform agglomeration.

The kind of apparatus or the method of agitation is important only in so far as it directly affects uniformity. In comparing apparatus and methods of flocculation, again for no apparent reason we find excellent results at one location and poor results at another; and we hear undue praise from the former and damnation from the latter. Under identical fundamental conditions (colloid, pH and temperature), mechanical or air flocculator can be made to stand or fall by the control of one factor, and that factor is *dispersion.* Dispersion is short-circuiting, and short-circuiting is lack of uniformity of treatment in successive units of liquor. Mr. Calvert, in his most interesting paper (in this issue), has very clearly shown the importance of the short circuiting factor.

The Importance of Dispersion

Comparisons of different methods or apparatus, or evaluation of any refinements in specific instances are meaningless unless they are made on the basis of respective dispersion. I have had occasion to compare various methods and devices for flocculation in the operation of a thirty thousand gallon per day experimental water purification plant. Taking into account probable errors of experimental observation, under controlled conditions of dispersion and operation, no difference in results could be detected from such widely divergent methods as air agitation and mechanical flocculators. Likewise, both air and mechanical systems were operated under a wide range of conditions such as speed, direction of rotation, shape and size, and no significant difference could be detected. Of course, certain changes in design and arrangement directly affect dispersion itself, and as such can be condemned or praised. However, comparisons under identical dispersion consistently and persistantly, over a wide range of conditions, produced identical results. Other factors constant, the key to successful flocculation is control of dispersion.

I should like to make it clear that dispersion must be measured by more than a qualitative method such as observation of the passage of a dye. I found that a most satisfactory and accurate quantitative index is adjustment and measurement of pH. Values plotted on probability paper give the distribution of the time it takes for various percentages of hydrogen ions to travel through the tanks. Arbitrarily, the dispersion index is taken as the ratio of time it takes to pass 90% of the ions to the time it takes to pass 10% of the ions. In a perfect tank the index would be one. The reciprocal of the dispersion is a direct measure of the efficiency of the tank in terms of its theoretical detention time. In fact, I found that this efficiency also was a measure of the overall results of the clarification treatment, substantiating the dominant role played by dispersion.

The dispersion index is an invaluable tool, not only in affording a sound basis for comparison of flocculators, but also as an aid in evaluation of designs. A tank of theoretical detention period of 30 minutes may be so designed as to produce a dispersion index of 5.0. In other words, its effective mean time is only one-fifth of the theoretical period. Flocculators or no flocculators, pin-point floc will develop in the sedimentation basin under such conditions. Theoretical detention periods are meaningless without their determined dispersion indices.

What Flocculation Devices Lack

I have ponted out briefly how we may find some explanation for inconsistencies observed in present practice. Though the previous speakers have most ably presented the case for the flocculators, at this point I should like to do a little violence to the art as now practiced. I pointed out previously that flocculation as now practiced is a combination of mixing and agglomeration in one operation. In my opinion, this combination of operations is fundamentally wrong and inefficient. Mixing presupposes agitation, but agglomeration requires quiesence. Under the usual present practice, mixing is reduced to a gentle stirring and agglomeration to a gradual build up under conditions of agitation. Try-

ing to go half way toward both, in my opinion we fail to satisfy either. Mixing should be vigorous agitation with one thought in mind, namely, to insure absolutely uniform distribution of coagulant in every unit of liquor during the period necessary for the chemical formation of floc nuclei. Only when this is accomplished, should we be ready to give thought to agglomeration.

What are the essentials for efficient agglomeration. First, agglomeration should be an independent operation, distinct and separate from all others. Second, it should be carried out in the shortest possible time in order to insure uniformity and avoid dispersion. Third, intimate contact must be had between the impurities and the floc so that when agglomeration does take place the impurities concomitantly precipitate with the floc. Fourth, we want tough, uniform and heavy agglomerations which can be separated from the clarified liquid completely and rapidly by some simple means such as sedimentation—leaving but little for the filters to remove thereafter.

It is my firm conviction that rather than through integrating diverse functions into a single operation, progress and improvement in clarification by coagulation will be made by breaking down the various essential functions into independent operations, each carried out as a separate step. It is in this way that conditions ideal for each can be developed and the maximum efficiency obtained.

IMPORTANCE OF REMOVAL OF GREASE FROM SEWAGE

Boston, Mass.

To the Editor:

The paper by Gordon J. Wiest on "Degreasing Sewage," appearing in the December, 1938, issue of Water Works and Sewerage, is a noteworthy contribution toward solving sewage problems. It supplies us with a plant scale demonstration of the value of chlorine in conjunction with aeration in the removal of grease from sewage. At Lancaster, Pa., the value of the process is largely in the improvement apparently effected in the operation of the subsequent activated sludge process. However, the aero-chlorination process may also assume considerable importance in conjunction with skimming - sedimentation tanks in primary treatment of sewage prior to discharge into diluting waters where it is desirable to reduce the offensive condition ordinarily produced by grease balls and sleek.

In studying the analytical results, the writer was somewhat surprised by the relatively low quantity of skimmings removed even with aero-chlorination as compared with quantities removed at several plants where no provision is made for aeration or chlorination. The first thought was that the percentage of increase in quantity of grease removed as scum was the important factor to consider. A further study of the figures presented by Mr. Wiest indicated that the outstanding effect of the aero-chlorination process was not in the quantitative increase in grease removed as scum but in the increase in the removal of grease by sedimentation, as shown by the analysis of the sewage and effluent. To illustrate, the writer has computed the grease removal on the pounds per million gallon basis for the test periods given in Table III of Mr. Wiest's paper.

The striking figures to compare in this table are that whereas the weight of grease in the scum was increased by aero-chlorination from 0.2 to 1.9 lb. per m.g. dry basis, the apparent quantity of grease removed based on analyses of the sewage and effluents increased from 67 lb. per m.g. without aero-chlorination to 141 lb. per m.g. with aero-chlorination. The increase in removal based on weight of skimmings, amounting to 1.7 lb. per m.g. is insignificant compared with the apparent increase in removal of 74 lb. per m.g. indicated by the analyses to have gone down with the solids removed by the primary settling units.

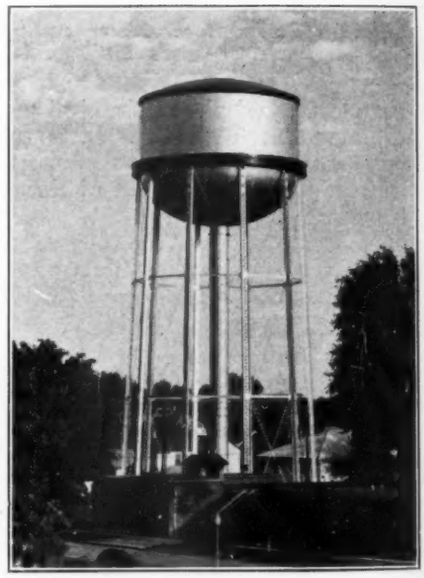
Duration of test, 1938	Feb. 15-21	Mar. 4-9	Mar. 16-21
Air used, cu. ft. per gal.	0	0.14	0.14
Chlorine used, p.p.m.	0	0	2
Wet grease removed, lb. per m.g.	1.6	3.0	12.5
Grease removed in scum dry basis, lb. per m.g.*	0.2	0.5	1.9
Grease in raw sewage, p.p.m.	21	26	21
Grease in effluent, p.p.m.	13	13	4
Apparent removal of grease, p.p.m.	8	13	17
Grease in raw sewage, lb. per m.g.	175	216	175
Grease in effluent, lb. per m.g.	108	108	34
Apparent removal of grease, lb. per m.g.	67	108	141
Percent reduction of grease	38	50	80

* Assume grease, dry basis, 15% of weight of scum.

It is desirable that similar data be collected in other places for comparison with the results of the tests at Lancaster and in particular to demonstrate the value of this process in the over-all removal of grease including not only that removed in the form of scum but also that removed with the settling solids.

Frank L. Flood,
Metcalf & Eddy, Engineers.

"SIMPLE BEAUTY"



To an editor's desk come many pictures of many things. Some have an appeal, many do not. This one from Pittsburgh-Des Moines Steel Co. did. Its lines of simple beauty, to us, makes this utilitarian structure at Newton, Iowa, stand out. It's a water tank and looks its part. But there is nothing to offend, and much to please the eye of such people as the real architects who admire symetry and trimness for its worth, preferring show of character and identity to veneer and camouflage.

THE ATLANTIC CITY CONVENTION OF A.W.W.A.

Proves Notable in Several Directions

A Permanent Board-Walk Exhibit

Novel "front-gate" to Crane's permanent exhibit consists of this giant motor-operated valve. (Petite Mrs. Geo. Tatnall and Mrs. A. Scheinert, posing.)

IN Atlantic City on June 15th the curtain was rung down on what proved to be one of, if not in several respects, *the,* most successful of A.W.W.A. conventions.

The 59th Annual Convention of the American Water Works Association opened officially June 12th and closed June 15th. However, the Exhibition of Equipment and Materials was in readiness for inspection by the many who arrived during Sunday the 11th. And, to accommodate those who arrived early and to reduce the usual "peak" of Monday's load, the registration desk was also put in operation early Sunday.

Without much question better than 1,500 members and guests attended A.W.W.A.'s 59th Convention. As to the official count of paid registrations, the figure of 1290 tops the 1140 at Buffalo in 1937 and the 1123 of last year in New Orleans.

Exhibits Outstanding

If one was asked what was the most impressive feature of the 1939 Convention, without much question he would name the Equipment and Materials Exhibits, which have never in A.W.W.A.'s history been equalled. In respect to spaciousness (involving nearly 7 acres of floor area), number of manufacturers exhibiting, the combination of instructiveness and the artistry employed in the 130 exhibit spaces arranged in a highly pleasing layout, the manufacturers' "show" was truly outstanding. So much was this evident that the Convention Place Committee recommended that this year's trial of holding technical meetings and exhibits in some spacious Auditorium be repeated in 1940. Such recommendation received the approval of the Board of Direction and, on this score, Kansas City was chosen as the 1940 Convention-City because its famed Auditorium is closely surrounded by several hotels. (The dates have not been set but these will fall early in the Spring.)

Presidents

Reeves Newsom (New York) Retiring

Arthur Jensen (Minneapolis) Incoming

Entertainment

Like the exhibit arrangements, the Atlantic City Convention entertainment and social functions also were rated as outstanding. At the various events much prosperity, sparkle and color was in evidence in the form of Miladys' gowns—(with and without hoops). Added thereto the swirl of rhythmic music the specification was completely met.

Norman J. Howard (Toronto) Vice-President

Hal F. Smith (Detroit) Diven Medalist

The variety stage show after the "All Section Dinner," of exceptional quality, proved of sufficient merit to register highly with the audience, later turned loose for a couple of hours of enjoyable dancing.

The most novel entertainment feature proved to be "An Evening in Monte Carlo", wherein the ballroom was adequately equipped with all of the better known gaming tables and devices of chance. With A. W. W. A. money ($1,000 bills specially printed for the purpose and allotted in equal amounts to all) each had the opportunity to test his luck, and to break the bank if possible. At the stroke of the curfew gong a couple of hours later, the largest winners received handsome prizes. In two hours of play several "Water Works Millionaires" were made—something novel to say the least.

Behind the Scenes

While there was lots of play during the 1939 convention, there was lots of work going on behind the scenes. An outstanding accomplishment of the convention was the work of A.W.W.A.'s most important technical committees, which held meetings and "hearings" all during the week. A.W.W.A. can boast a rather remarkable record in the way of progress by its rejuvenated or newly appointed technical committees, and considerable of it came to light through progress reports rendered. (Such will be briefed later in this report.) Particularly impressive has been the accomplishments of committees on Cast Iron Pipe and Fittings, Meters and Metering, Distribution System Records, Distribution System Safety, Service Line Materials, Steel Pipe, Valves and Hydrants, Joint Administration and Collection of Water and Sewer Accounts.

Honors and Awards

The Diven Medal

To Hal F. Smith, Commercial Manager of the Water Department of Detroit, went the John M. Diven Medal for conspicuous services to the Association. Mr. Smith was cited for his leadership in the prepa-

ration of the Manual of Water Works Accounting, which issued during the year and has since proved of such high value.

The Goodell Prize

For their joint paper—**"Some Problems Relating to Legal Control of the Use of Ground Water"**—Messrs. David G. Thompson and Albert G. Fielder, Engineer of the U. S. Geological Survey, received the John M. Goodell prize. Their paper, which appeared in the Journal for July, 1938, was cited as "one combining wide research and interpretative scholarship in the presentation of a study of high importance to water supply practice".

David G. Thompson (Washington, D. C.)

Albert G. Fiedler (Washington, D. C.)

(To Them the John M. Goodell Prize)

Honorary Memberships

Five distinguished members were recognized by awards of Honorary Membership.

Frank A. Barbour, Consulting Engineer of Boston; a past-president, and a member since 1906, "who has been unflagging in his leadership in the affairs of the Association."

Carlton E. Davis, Manager of the Philadelphia Suburban Water Co., Bryn Mawr, Pa.; a member since 1912 and a past-president, "whose services contributed materially to the Association's present standing."

Charles Gilman Hyde, Professor of Sanitary Engineering in the University of California, a member since 1907 and retiring Chairman of the Water Purification Division, "a leader and teacher of men whose influence is nation-wide."

Beekman C. Little, Secretary Emeritus of the Association and resident of Rochester, N. Y.; a past-president and for 10 years Secretary of the Association, "a genial leader, who contributed materially to the present standing of the Association."

Harry E. Jordan, Secretary of the Association since 1936, a member since 1919, a past-president and Diven Medalist, "who has served the Association in many capacities and in a distinguished manner; who, as an organizer and executive, has brought the Association to its present status and its advanced recognition, through untiring work and able leadership."

Convention Management

Wm. J. Orchard (Wallace & Tiernan Co.) The General

Chairman J. Herman Smith (Hersey Mfg. Co.) In Charge of Exhibits

The George W. Fuller Awards

The George W. Fuller awards are given members of the Association deserving of recognition for some outstanding or distinguished service in the water-supply field. These awards are made annually in commemoration of George W. Fuller, who become a distinguished engineer of brilliant diplomatic talent, and whose constructive leadership of men meant so much to the Association.

In his brilliant recounting of the achievements of the man Abel Wolman, in making the presentations of the certificates to recipients, aptly referred to George W. Fuller as "that sturdy pioneer in Sanitary Engineering," which he was.

Those honored by the award were:

Member	*Section*
G. E. Arnold,	California
A. M. Bowman,	Canadian
E. C. Trax,	Central States
A. P. Black,	Florida
J. W. Armstrong,	Four States
J. R. Baylis,	Illinois
H. A. Dill,	Indiana
H. F. Smith,	Michigan
J. W. Pray,	Missouri
F. E. Brandis,	Montana
W. G. Banks,	New Jersey
E. P. Stewart,	New York
W. R. LaDue,	Ohio
W. C. Lawrence,	Ohio
Alex. Lindsay,	North-West
D. E. Kepner,	Rocky Mountain
A. A. Passolt,	Southeastern
F. W. E. Weisse,	Southwestern
L. A. Smith,	Wisconsin

The Hill Cup to W. Va.

That coveted price—the Nicholas S. Hill Cup—which goes annually to the Section gaining the greatest number of members in ratio to existing membership in the Section, was won by the new West Virginia Section, which more than doubled its membership (117.4% gain) during the period since it split off as a State Section from the old Central States Section. In second place came the new Ohio Section, which because of its already existing membership number, at the time of formation, had a much more difficult task of leading on a percentage gain basis. The Minnesota Section—that of A.W.W.A.'s new president—moved into third place.

The Henshaw Cup to N. C.

The cup donated by Franklin Henshaw, Water Superintendent of Scarsdale, N. Y., is awarded annually to that Section showing the best attended meeting, based on ratio of active members in attendance to total registration. The winner of the year was the North Carolina Section which, incidentally, plans through a vigorous new member campaign to take the Hill Cup in 1940—something which this Section has previously done on more than one occasion.

In the Henshaw Cup contest this year the Montana Section ran in No. 2 position.

North Carolina Cup Winners

Chairman W. M. Piatt, Immediate Past Chmn. J. W. Kellogg

(Took back to their Section the Henshaw Cup)

We regret that Director Frisk could not be located when this picture was snapped. —Ed.

Southeastern Section Wins New Award

During the year a new award was established—namely, that to the Section which can show the maximum man-miles of member-attendance at the Annual Convention. The

Southeastern Winners

Director J. K. Marquis, Chairman Paul Weir, Sec'y.-Treas. B. P. Rice
(Took home the banner denoting best Section Convention Attendance Record)

award is known as the Section-Convention Attendance Award, which carries with it a handsome banner for continuous possession of the Section and display at meetings. The members of the Section in attendance are given a distinguishing badge to wear during the Convention at which the award is won. The method of determining the winner is not a count of members, but is based on the total number of miles traveled to the convention by those members registering from each Section. To Atlantic City came 50 of the 124 members in the Southeastern Section. On hand was the Director, the Chairman and the Secretary, to receive the first banner awarded for maximum man-miles of convention attendance. Second in the running came the Illinois Section.

Col. Willard F. Rockwell Pittsburgh Equitable Meter Co. (Elected President by the Manufacturers' Ass'n.)

Joseph M. Wafer Industrial Chemical Sales (ArrangedAll-Section Dinner Show)

The Old Oaken Bucket to California

A special award was made to that Section showing the largest total membership at the beginning of the Convention. This award turned out to be an old well bucket, for which scouts had been sent out into the country-side of new England where the prize was found. The winner proved to be the California Section (455 members) which had nosed out the New York Section from first position during the year. (Since only two sections had any chance of winning, The "Old Oaken Bucket" trophy was in reality a challenge from the East to the West in connection with membership selling.)

Appreciation to President Newsom

At the closing banquet of the Convention, the Board of Directors made a special presentation to Reeves Newsom, as out-going president, in appreciation of his untiring services as president and the appreciable amount of time devoted thereto at a known sacrifice of his personal interests. The gift consisted of a handsome antique silver tray and four harmonizing silver candlesticks.

New Jersey Committees Function Effectively

For the smooth running of the social side of the convention, and facilities arranged for the convenience of those attending, much credit must be given to the system set up by "Bill" Orchard, General Chairman of the Convention Management Committee, and "Clint" Inglee, as Chairman of the Entertainment Committee, in which a number of co-operating committees were set up, consisting of members and wives of members in the New Jersey Section. These "host and hostess" committees proved so highly effective that a precedent may have been established in the handling of local affairs in future conventions.

Some Program Highlights

(A Governor Speaks)

On the second day of the Convention, the Honorable A. Harry Moore, Governor of New Jersey, left a busy session of his Legislature in Trenton to come down to Atlantic City and address the Association on **"The Importance of a States Water Resources."** Also, to tell waterworks men what he personally thought of their work, and to comment on the value of water works associations to communities as well as individuals.

The Governor has an especial interest in, and insight into, water supply. In this, he outlined his recommendation for enhancing the water supply in the metropolitan area of Northern New Jersey by converting the State-owned Delaware and Raritan Canal to a potable

A Water Minded Governor Speaks
(President Newsom in the Chair)

water supply canal taking 150 m.g.d. from the Delaware above Trenton, purifying it and delivering by pumping to storage reservoirs supplying the Newark-Elizabeth-New Brunswick area.

The Governor, interestingly reviewing some of the part that New Jersey has played in water supply and purification history, pointed out that in New Jersey the first mechanical filter for public supply was installed. Then, too, he recalled that in New Jersey the first application of chlorine for rendering a public supply safe was put into effect on the Jersey City supply at Boonton, N. J., in 1908.

He closed by noting the high morale amongst water-works men, their diligent and conscientious application to duty, long tenures by worthy men—and, more particularly, by those who attend waterworks meetings to keep abreast of developments and practices. In complimenting A.W.W.A. on its achievements, he "hoped and believed that it would, in the future, add even greater pages to its history".

Manufacturer Board Members
John R. Keinle (Mathieson Alkali Works) Sec'y. of Manufacturers' Ass'n.
Clinton A. Inglee (National Water Main Cleaning Co.) Entertainment Committee Chairman

Burgess on New Jersey's Problem

Following Governor Moore came Geo. S. Burgess, Chairman of the State Water Supply Commission, to briefly review water supply history in New Jersey since the establishment of its first State Water Supply

Chairmen

Dale L. Maffitt, Des Moines, Ia. (Of the Finance & Acc'tg. Div.); Malcolm Pirnie, New York, N. Y. (Of the Water Works Practice Comm.); Chas. H. Spaulding, Springfield, Ill. (Of the Water Purification Div.)

Commission in 1872, which has had a varied history since. The water supply problem of New Jersey is in reality two distinct problems—that of surface supplies of the upland (Northern) districts and the ground water supplies of the coastal region. He reviewed the history of the successful North Jersey Water Supply Commission. This Commission operates supply reservoirs and trunk mains from which water is allotted to and paid for at wholesale rates by 8 municipalities, which have jointly financed the supply works but retail through their individual city-owned distribution systems.

Chairmen

A. P. Kuranz, Supt., Waukesha, Wisc.; T. L. Amiss, Supt., Shreveport, La. (Incoming and Retiring Chairmen of the Plant Management Div.)

Mr. Burgess remarked that during the decade since 1929 there had been noted a fortunate decrease in consumption, allowing more time and mature consideration in planning for future increases. He revealed that a 5-month survey and study had been gotten under way by the State Water Commission, the North Jersey Commission and the W.P.A. jointly. He also revealed that the authority of the State Water Supply Commission lay largely in its power of veto. It carries no authority to construct works, but has regulatory powers in various degrees.

Wolman on Labor Relations

Dr. Leo. Wolman, Professor of Economics at Columbia University, and Staff Member of the National Bureau of Economic Research, New York City, had been invited to discuss **"Labor Relations in Water Works Plants".** Upon survey he had found that little or no labor problem existed in water works plants, so he discussed the labor problem in general and, more specifically, labor relations in the public service field in which trade unionism has been growing since 1933 at an accentuated pace.

The former N.R.A. official, who played an important part during the strikes by workers in the automotive industry, reviewed the history be-

From Jersey to Honolulu

H. P. Croft, Trenton, N. J., Chief Engr. N. J. Dept. of Health and Wm. C. Flanders, Harrison, N. J., Sales Mgr. Worthington-Gamon Meters (Co-Chairmen "A Night in Monte Carlo"); Frederick Ohrt, Manager and Ch. Engr., Bd. of Water Supply, Honolulu (A distinguished member pays us a visit.)

hind British labor movements—their downfall as the result of the General Strike of 1926, and the resulting Labor Act of 1927, which has resulted in more moderate demands by labor leaders and peace between labor and industry. Dr. Wolman pointed out that the British act prohibited Civil Service employees from joining labor organizations which draw members from outsde of the Civil Service. In America, where British history may be repeated, this would mean that no Federal, State or City employees in the Civil Service could belong to the C.I.O. or American Federation of Labor.

Dr. Wolman's review of what has been happening to boost wages since 1933 revealed the most rapid rise in

For and "Ag'in" New Dealing

Dr. Abel Wolman (left) replying to Carl Chatters (right) Exec. Director, Munic. Finance Officers Ass'n on the topic "Recovering from the Recovery Program."

real wages in history. The "real" wage he described as the net result from a combination of increased dollar wages with the sustained high commodity buying power of the dollar. The dangers of wage increase is always less employment, which in turn has meant Federal absorption of the unemployed, and more Government spending. In the latter plan, there were limits as to what an economic system could stand, and such limits seemed closer at hand to the speaker than some would care to admit.

In looking ahead, the future problems in Civil Service would appear to be two, in general.

(1) Salaries and wages in public service are to lag behind those available in private enterprise.

(2) Employment in the public service field is obliged to begin to decline, rather than to expand as has been so prevalent in recent years.

"Recovering From the Recovery Program"

One of the most dramatic and thought provoking of the papers and discussions on the program was that

(1) Mrs. R. D. Watkins (nee Amiss) of Meriden, La.; Thos. L. Amiss, Sup't. of Water & Sewerage, (Shreveport, La.) and Mrs. Amiss; (2) Roger W. Esty, Sup't. of Water (Danvers, Mass.) and Mrs. Esty; (3) Chas. E. Moore, Manager Water Works, (Roanoke, Va.) and Mrs. Moore; (4) J. E. O'Leary, Gen'l. Sales Mgr., Pittsb'g DesMoines Steel Co. (Pittsburgh, Pa.) and Mrs. O'Leary; (5) L. E. Goit, Sup't. of Distribution, (Los Angeles) and Mrs. Goit.

(1) Mrs. Fred Stuart, (Baltimore, Md.) and Mrs. Tom Quigley (Chicago); (2) C. J. DesBaillets, (Chairman Canadian Section) and Mrs. DesBaillets; (3) and (4) Snapped on the Board Walk (in the group we recognize Tom Wolfe of Chicago); (5) Geo. E. Willcomb, Sup't. Purification, Albany, N. Y. and Mrs. W.; (6) Mrs. Abel Wolman and Doctor Wolman, Johns Hopkins University, Baltimore.

by Carl H. Chatters, Executive Director, Municipal Finance Officers Assn., Chicago, on the topic **"Recovering From the Recovery Program'**, and the discussion which came from Dr. Abel Wolman, Chairman of the National Water Resource Committee, and Professor of Sanitary Engineering at Johns Hopkins University.

Mr. Chatters confirmed the statements of Dr. Leo Wolman that the recovery program had involved a 50% boost in "real" wages. The program had kept many from starving perhaps, but had definitely failed in reducing unemployment. In the interim the National Debt had increased from $16,185,000,000 (the post-war low) to $40,277,000,000 at present, without attaining the ends sought—namely, correction of unemployment. Farm products have decreased 40% or more, while industrial wages have increased, but unemployment remains as conspicuous as ever.

Mr. Chatters emphasized the fact that the paternalistic financing of public works has been rapidly changing our political structure. The "bait" of Federal aid offered has forced local governing bodies to follow Federal Administration dictates —this even to the extent that numerous cities are now burdened with many non-essential public enterprises which they can not afford to operate or whose debts they will be unable to liquidate. One serious result has been the decline in local leadership, which has been supplanted by "uniform methods" and regimentation.

An interesting comment by Mr. Chatters revealed that the people in the medium wage earning classification were already paying the bill for state and local relief because these funds have been coming almost entirely from property and sales taxes. He plead for a return to old-fashioned honesty, straight down the line, and the return to an economic system governed by the competitive price system, rather than the political system governed by competitive pressure. Or, if the tide of centralization can not be turned, then bulwarks should be erected to prevent its further onrushes.

Hosts

Chrystal Brown, Wanaque, N. J., Sup't. North Jersey Water Supply Commission and L. Van Gilder, Atlantic City, N. J., Sup't. and Ch. Engr. Water Dep't.

He criticized "Business" for a degree of intolerance and unwillingness to formulate a sound recovery program. The National Budget would have to be balanced sooner or later by increasing income through taxation or by inflation. Leaders of business would sooner or later have to stop considering profits of the immediate day and look further ahead for the ultimate solution. The Federal Government should stop trying to be all things to all people, and should decentralize its activities. Until a definite statement of policy has been issued by Government, Labor and Industry, nothing permanent could be expected in the mind of Mr. Chatters.

Dr. Abel Wolman, in discussion, started with the premise that history had shown that emotions and people (not logic in science) controlled political developments; that in America the period 1930-1939 embraced a revolution—but fortunately a peaceful one, which could not be said of previous revolutions. The important consideration for the moment was the behavior and status of the people. In America every reform had brought intervention and a back-swing of the pendelum. In this instance a swing back to complete lack of Federal and State intervention or regulation would be to lose all of the gains, and he pointed out that the entire art of water purification and waste disposal was based on a form of intervention and regulation which had proved highly useful.

Dr. Wolman also pointed out that gratuities accepted must admit of some regulation. Also, that he was in agreement that local and State leadership is preferable to Federal paternalism, but added that there seemed to be no willingness to lay aside such paternalism. Better, all of this, than the conditions which existed in cities of this same America in 1873, concernng which he read a newspaper account of starving children eating rotten fruit and vegetables from the market gutters.

[Two more installments of this report will be required to complete it. These will follow in our July and August issues.]

(1) Walter E. Walker, Sup't. and Ch. Engr., Water Dep't., (Poughkeepsie, N. Y.) and Mrs. Walker; (2) Thos. A. Cole, Sup't. of Filtration (Poughkeepsie, N. Y.) and Mrs. Cole; (3) Mrs. Joseph E. Rehler and Mr. Rehler, Sup't. of Water Works (Olean, N. Y.); (4) R. G. Yaxley, Sup't. Water (Waterford, N. Y.) and Mrs. Yaxley; (5) H. L. Field, Engr. and Sup't. of Water (Greenfield, Mass.) and Mrs. Field.

OHIO SECTION AT DAYTON OFF TO EXCELLENT START

Endorsement by Director Morehouse's Mayor Hits the Bull's Eye

LESS than nine months old, the new Ohio Section of A.W.W.A. took its stride in its first annual meeting April 27th and 28th in Dayton—the home-town of the Section's first Director—"Wally" Morehouse.

With a registered attendance of 128 (115 men and 13 ladies) Ohio's Section was off to an excellent start. Having but 90 odd members when organized, it seemed assured that this number would reach 150 shortly after the meeting, if not actually during it. Thus is emphasized what results may be attained by a live-wire Membership Committee headed by a "wheel-horse" such as Hayes Kuhns. Commenting on its growth, Reeves Newsom, President of A.W.-W.A., pointed out that the Ohio Section had put itself in line to win the Nicholas S. Hill Cup for 1939.

(Wise, analytical, Ohio executives reasoned that peddlers might well be selling A.W.W.A. memberships along with other things needed by waterworks men; so, the Membership Committee was composed principally of salesmen. The wisdom of interesting these "Ambassadors of Commerce" in taking on A.W.W.A. membership selling, as a "side line," can be no better illustrated than in noting the end result. We have observed parallel cases and wish to recommend the method to other A.W.W.A. Sections. It clicks!—*Ed.*)

Mayor Makes Real Speech

Not content with a mere welcome, Mayor Charles J. Brennan's address proved that he should be appointed as a "Committee of One" to sell the value of A.W.W.A. at Mayor's Conferences, and to sell Chambers of Commerce and other civic organizations on the value of the water utility to the community.

He was strongly in favor of water works men keeping abreast of developments and improvements, made possible by attending as many water works meetings as permissible. Then too, he urged water utility managers and executives to do more to impress on the public the importance of high quality water service, and the real work that is behind the service rendered. In short, he advocated two things that every water works man should do: (1) Attend meetings, and make contacts; (2) Strengthen public relations by publishing the local water system and the value of the service rendered.

Chairmen—Medalists

W. R. LaDue, Akron (Retiring Chairman, Fuller Medalist, Director Elect); W. C. Lawrence, Cleveland (Chairman and Fuller Medalist)

Trustees and Wheel Horse

F. P. Fischer, Cleveland; C. E. Inman, Warren; Hayes Kuhns, Killbuck (New Member Committee Chairman).

It was the sort of speech that some water works man might compose for a Mayor. It was the perfect speech of a thinking executive.

LaDue and Lawrence Voted Fuller Award

To the retiring Chairman W. R. LaDue (Akron) and his team-mate W. C. Lawrence (Cleveland) went the George W. Fuller Award for 1939. In announcing the decision of the Award Committee, Clarence Bahlman (Cincinnati) explained that these two officers were equally deserving of the honor, in recognition of the work jointly done to get the Ohio Section established and to foster its well being and strengthening its growth since organization. (The presentation of the Award is to be made at the pending A.W.W.A.

Ohio Director and Secretary

W. W. Morehouse, Dayton; T. R. Lathrop, Columbus.

Officers Named

The following slate of officers presented by the Nominating Committee, through Frank E. Tolles as chairman, were unanimously endorsed:

Chairman, Wm. C. Lawrence, Commissioner of Water, Cleveland; Vice-Ch'rm'n, M. F. Hoffman, Supt. Commercial Dept., Cincinnati; Secretary-Treasurer, T. R. Lathrop, State Dept. of Health, Columbus; A.W.W.A. Director, W. R. LaDue, Supt. of Water, Akron; Trustees, C. E. Inman, Supt. of Water, Warren; Philip Burgess, Consulting Engr., Columbus; F. P. Fischer,W., & T. Co., Cleveland.

The Convention Place Committee (Paul Cook, Painesville, Chairman) announced that the 1940 meeting would be held in Akron—the home city of the Section's first chairman, and now A.W.W.A. Director. The exact date is to be set later.

Morehouse Highlights Dayton Water System

Following Mayor Brennan, who thinks a lot of Dayton's Director of Water and Sewerage, came camera-fan Wallace W. Morehouse (the Director) to show his color films, with a running description, of "The Water Supply System of Dayton." The supply is derived from a field of wells put down in a glaciated valley, the water being delivered without treatment beyond chlorination. The newest wells are 80 to 100 ft. in depth and 38 inches in diameter, developed as gravel-wall wells yielding between 2 m.g.d. and 7.5 m.g.d. each. Well

(1)—"Bill Meissner, Farnan Brass W'ks., Cleveland ("Ace new-member-getter") and R. D. Nichols, Jeffrey Mfg. Co., Columbus. (2)—"Mike Foley, Hersey Meter Co., Chicago and "Bill" Birch, Pres. Birch Mfg. Co., Chicago. (3)—Carl Eberling, Sup't. of Water, Cincinnati; President of A.W.W.A. Reeves Newsom; Cyrus Birn, The Pitometer Co., Detroit (Chairman Michigan Section). (4)—Frank Brainard, Jr., "Meter-Master" Representative, Hartford, Conn., and Eugene Hargett, Ford Meter Box Co., Wabash, Ind. (5)—Philip Burgess, Cons. Engr., Columbus (Section Trustee) and Prof. George Barnes, Case School, Cleveland (Round Table Chairman).

pumps deliver to a suction reservoir at the main pumping station in the city. On the system floats three reservoirs of 19 m.g. capacity each for low service (185 ft. head), from which water is boosted to 5 large ground-tanks and two smaller standpipes (350 ft. head), located in divergent sections of the city's fringe, to provide high level service.

In reply to questions, Mr. Morehouse stated that the only objectionable quality of the supply was its hardness. The large number of existing household zeolite softeners had been a stumbling block in efforts to interest taxpayers or officials in the construction of a municipal softening plant.

Operating Dayton's Departments of "New and Used Water" jointly (Water Works and Sewerage) had its advantages. First, in providing ample funds for efficient and economical operation, and betterments such as the recent enlargement of the Sewage Treatment Works. Sewerage charges average 33% of the water charge. Second, the fact that the "Department of Used Water" contributed 33% of the cost of billing and collection of both charges. As to sewer charges on water used in sprinkling, that had been taken care of in setting an allowance of 3000 cu. ft. as the first block covered by the minimum charge for sewer service.

An Entertainment High Spot

The Ohio Section set an example of what can be attained in the way of entertainment at a minimum of expense, at cost to those who attend sectional meetings. Certainly the high-spot of entertainment was the showing of the remarkable movie film taken by one of Dayton's No. 1 citizens, and friend of the Director of Water and Sewerage. Following the annual dinner, Toastmaster Morehouse introduced Mr. William Crist, General Motor's vice-president in charge of research. Mr. Crist had made a trip by boat down the Colorado River through an exceptionally colorful and picturesque section of the Grand Canyon. His hobby is color photography, and his pleasure is that of showing his exceptional films which his audience rated professional.

Programmers

Geo. Tatnall, Chicago (Nat'l. B'd. Fire Underwriters); M. J. Hoffman, Cincinnati (Commercial Mgr., Water Dep't.); A. E. Kimberly, Columbus (Consulting Engr., State P.W.A. Engr.).

Technical Sessions

"Consumer Accounting and Collection Practices" by M. F. Hoffman, Supt. of Commercial Division, Water Department, Cincinnati, Ohio.

Mr. Hoffman briefly described the two plans most universally used in consumer accounting (billing and collecting) for utility services—the older dual ledger card and bill method and the newer, and more flexible, stub plan of accounting and billing. In considerable detail he described the working of the latter plan and presented experiences with it at Cincinnati, which revealed it to be simpler and more practical, less costly of operation and giving absolute control of revenues. In addition, it permitted greater flexibility, allowed payment of water bills in installments resulting in better public relations and made more expeditious the follow-up on delayed payments by slow-pay consumers. All of this resulted in the minimum of delinquent accounts, with least cost for collection and minimum loss of consumer good-will.

In Cincinnati there are now 102,000 consumer accounts—all metered. Meters on 2,000 commercial accounts are read and billed monthly. From such, yielding 50% of the total income from water sales, the flow of income is smooth and extended delinquencies of importance are prevented. Also about 20,000 meters on rented properties are read monthly but billed quarterly. This in order to hold down water-waste and protect owners of the property held responsible for water bills by City Ordinance. Notices of high readings are followed up by inspection and re-readings three days thereafter to see if proper repairs have been made.

Routine billing and collection consists of rendering the bill, plainly showing due-date 10 days later. Although 80% of the bills are paid within the 10 day period, 20% require the following collection routine. The delinquent *notice* stub (already prepared by the Burrough's billing machine, without additional operations, at regular billing time) is mailed in pennysaver envelopes three to five days after the due date. The amount of the delinquency is not shown. The notice merely states that grace period for payment expires seven days from mailing date, and payment must be made therein, to escape collection penalties. If not paid in grace period a delinquent *bill* is prepared on typewriter, at a charge of $1.00 for such special service, and handed to bonded turnkeys for collection with five days, or service shut-off. Experience reveals that not more than three out of 300 services have to be shut-off, because partial payment (if justifiable) can be arranged and is inexpensively taken care of with the stub method of machine accounting.

When the delinquent notice is not deliverable by the Post-Office, its return serves automatically as a follow-up or a shutoff order as the case may require. As a matter of interest about 70% of all bills are paid by mail, reducing much congestion during office hours. The cycle scheme of billing at 10 day intervals materially smoothes out peaks and valleys of rush-work in handling the 100,000 accounts at the routine rate of about 11,000 every 10 days.

Mr. Hoffman pointed out that the stub plan of machine billing had made possible the handling of 102,-

(1)—Sam. Shenker, Chemist, Columbus Purification Plant, and John Gettrust, Engr. of Pumping and Filtr., Akron. (2)—"Sterelator" Everson (R. B.) Everson Mfg. Co., Chicago, and "Precision" Harper (E. E.), Omega Machine Co., Kansas City. (3)—E. L. Gaudin, Mathieson Alk. W'ks., Cincinnati, and John A. Marsh, Sup't. Baldwin Filters, Cleveland. (4)—Martin Low, and A. E. Boss, Columbia Alkali W'ks., Barberton, Ohio. (5)—"Bob" Webber, Distr. Mgr., Mathieson Alk. W'ks., Cincinnati and W. C. Lawrence, Commissioner of Water, Cleveland (Ohio's New Chairman and Fuller Medalist—1939).

000 accounts by the same office personnel that had taken care of only 88,000 accounts nine years ago. Only one meter reader had been added in the nine year period of developing the cycle system and modernization of accounting procedures. In addition, the monetary savings which had been passed on to consumers during the eight years in the way of rate reductions had amounted to approximately $565,000 per year. (So it seems plain enough why Mr. Hoffman asked forgiveness if he seemed to favor the stub plan over the dual-ledger card method or any other scheme.—*Ed.*)

Water Dep't. Liability

"Liability of Water Departments for Leak Damages" by Phillip Burgess, Consulting Engineer, Columbus, Ohio.

Mr. Burgess, in discussing "Legal Aspects of Water Works Operations" dealt primarily with damages arising from leaks in water mains or services to the consumer property line. He pointed out that to successfully sue for damages from leaks, negligence on the part of the water utility must be shown by the plaintiff. He pointed out that even in municipal operations only two functions are adjudged as governmental functions amongst water works operations—namely, fire fighting and street flushing. Ordinary main flushing is not considered a governmental function.

In points of demonstrated negligence Mr. Burgess cited the following: (1) When known acts of non-employees are not protested or corrected; (2) Failure to make prompt and efficient efforts to stop leaks; (3) Lack of properly located shut-off valves to effectively isolate sections of main; (4) Failure to provide and properly train emergency men or emergency crews for immediate duty in manipulating valves, locating leaks and making emergency repairs. Several cases of such failures were cited.

Another proven type of negligence involved leakage of polluted water into conduits. This brought up the question of how far the responsibility of water utilities could be determined at Court if damages could be shown to be due to negative pressure on the main and resultant back syphonage through consumers' fixtures into the water main.

M. V. Weir, Supt. St. Louis County Water Company (by letter) reported a case of damages resulting from main flushing. In this case the hydrant could not be closed and the stream prevented reaching the shut-off valve on the hydrant branch. He urged that detailed records of every leak be taken and preserved for possible future need in case damage claims are subsequently filed.

Programmers

L. L. Hedgepeth, Philadelphia (Penna. Salt's Director Tech. Service); Harry Faber, New York City (Chlorine Institute's Research Chemist)

Worshipers, they, of the "Green Goddess"

W. W. Brush, Editor, "Water Works Engineering" expressed the opinion that the Water Department or the City was in truth responsible for all damage resulting from main breaks as well as from leaks and should not contest claims for damages if real.

"Utilizing the Ohio Conservancy Act for Developing Water Supply and Sewage Disposal" by F. H. Waring, Chief Engr., State Dept. of Health, Columbus, Ohio.

Mr. Waring reviewed the fact that the original Ohio Conservancy Act (1914) had been amended in 1937 so as to include water supply and sewerage developments in addition to flood control works. All existing water and sewage plants in a Conservancy District automatically became the property of the Conservancy. Improvements may be financed through issue of revenue bonds secured by operating revenues and sewer rental. Some of the details of functioning of the Conservancy were enumerated, along with benefits therefrom.

"Water Comes to 'Main Street," was the title of a paper presented by A. Elliott Kimberly, Consulting Engineer of Columbus, Ohio.

Mr. Kimberly, former State P.W.A. Engineer, reviewed the benefits to Ohio communities which had come in the form of water works and sewerage betterments through Federal aid, and the prompt and successful efforts of engineers of the State Dept. of Health in interesting municipal officials in such betterments.

Ohio possibly leads all states in the matter of numbers of new water supply systems in the smaller communities—there being 86 complete new systems in communities ranging in population from 200 to 2,600. Of this number 64 were financed through the P.W.A. and 22 through the W.P.A. As Mr. Kimberly pointed out, the Ohio enabling act of 1933 which made it permissive for these burdened communities to raise needed funds through the issuance of revenue type bonds, was an essential part of the program which otherwise would have been impossible. In the program were included 74 treatment plants (many on existing systems) and 56 other projects, such as providing storage by reservoirs or elevated tanks. The aggregate expenditure (P.W.A. projects alone) has amounted to $33,260,000 in Ohio for water supply betterments alone.

In reviewing the history of revenue bond type of water supply financing the scheme goes back to 1851 when Lebanon, Ky., was authorized by legislative act to issue revenue bonds and construct a public water system. Another early case was that of Wheeling, W. Va., in 1885.

An interesting aspect of the Ohio

(1)—Frank Tolles (C. E.), Geo. Gascoigne & Associates, Cleveland, and Harvey Jones (C. E.), H. P. Jones Engrs., Toledo. (2)—"Al." Scheinert, Rensselaer Valve's Distr. Mgr., Pittsburgh, and F. H. Rauscher, Sup't. of Water, Piqua, Ohio. (3)—Paul Cook, County Engineer of Water and Sewerage, Painesville, Ohio, and "Jo" Eqolf, Jr., Ludlow Valve's Distr. Mgr., Pittsburgh. (4)—Bert Brumm, Distr. Mgr. for "Water Works & Sewerage" Cleveland, and Cecil K. Calvert, Chemical Engr. and Sup't. of Filtr., Indianapolis Water Co. (In ability as in appearance—Distinguished).

program was the matter of metering. Meters were considered an essential part of the system, and likewise the service lines into the house were in many instances installed by the municipality to encourage consumer connections. Thus, said Mr. Kimberly, as the result of Federal Aid "water has come to 'Main Street'; not as an inundating torrent, but as a community force, an agent of potential growth and future prosperity."

In Fire Protection Where Do We Stop?

"Considerations of Distribution System Design for Adequate Fire Protection" by George Tatnall, Engineer, National Board of Fire Underwriters, Chicago.

In this presentation, Mr. Tatnall cited some of the fundamentals in new system design but more especially considerations of the first order in strengthening existing systems in moderate sized cities and towns. He sketched a hypothetical existing system, such as is likely to be found in a city of 28,000 population, and proceeded to indicate improvements needed to provide the required 3,500 g.p.m. fire flow and raise the adequacy of the system for securing a higher classification. He first added a tank of 1 m.g. capacity on the side of the city opposite the pumping station, and, almost as important, added a dual feeder artery to create a loop through the high value district and pass all important buildings and schools. Finally came the distribution grid, eliminating dead ends and mains of 4 inch diameter and under. (To this, Chairman LaDue replied that 4 inch mains were no longer allowed in Ohio cities.)

Frank C. Tolles, of George Gascoigne and Associates, Cleveland, Ohio, in an excellently presented discussion from the engineer's point of view, pointed out what appeared sound economics in the question of where to stop in water supply betterments to lower the net cost to a community for fire insurance costs plus protection. In what he termed "honest engineering" the consultant must weigh the cost to the community of each successive betterment laid out in a progressive plan extended into the future. Where to temporarily stop in the matter of adequate protection was not always simple to decide. In general, it was unusual when an economic balance between insurance reductions and betterment costs to meet fire underwriters' recommendations could be struck. Mr. Tolles pointed out that, after all, in the total 5,000 points involved in making insurance ratings the perfect water supply system would account for only 1700 such points, and the betterment cost curve reached a status of rapidly diminishing returns as perfection was approached.

Mr. Tatnall explained that even at 1700 out of 5000 points no other single item was given as many points as water supply. He added that in the smaller cities 80 to 90 per cent perfection in water supply requirements was not economical, nor was such expected by the Underwriters.

Chlorine and Chlorination

"Developments in Processing and Packaging of Chlorine" by L. L. Hedgepeth, Director Technical Service, Penna. Salt Mfg. Co., Philadelphia, Pa.

Mr. Hedgepeth stated that 99.8% purity of chlorine was no longer considered sufficient in connection with modern chlorinating equipment. In consequence a new method of purifying chlorine going into the sanitation field had been developed. It involved fractional distillation and scrubbing of the vapors with liquid chlorine "rain" to remove the residual gummy impurities. Recovery of the scrubbing liquid (chlorine) by controlled evaporation left a residuum of sludge for discarding.

Amongst the most important considerations now being given chlorine packaging was the costly investigation and study of the fusible plugs so essential in chlorine containers for pressure relief in case of fire or other undue heating of containers. As the result of requests by A. W. W. A.'s Committee on Chemical Hazards, that fusible plugs be discontinued because of hazard from leakage through or around the metal, members of the Chlorine Institute had instituted a searching study of the question. Such studies had proved the fallacy of abandoning the protective fusible plug, which precludes explosive rupture of steel containers. The next step involved an exhaustive study of composition and methods of pouring these plugs. The outcome is the present development of new specifications for fusible plug composition and pouring methods to preclude both shrink and quick chill granulation. (This represents the second major development through Association efforts and cooperation of members of The Chlorine Institute in improving chlorine containers. The first effort resulted in The Chlorine Institute Standard Valve for chlorine containers. And, now an improved and safer fusible plug for containers.—Ed.)

"Some Present Day Uses of Chlorine in Water Purification," by Harry A. Faber, Chemist, The Chlorine Institute, New York City.

Mr. Faber, in presenting 10 years of chlorination advances in water supply (in as many minutes) did a commendable job in the time available. He pointed to the growing practice of pre-chlorination and its merits. In connection with ammonia-chlorine treatment and maintenance of residual chlorine in the pipe system, application of chlorine first and ammonia thereafter to fix the residual as chloramine was to be preferred where permissible, i.e., where no taste production resulted from chlorination. The reasons for reversing the two applications were economy as well as a quicker sterilization effect and a more persistent residual due to the fact that chlorine demand had been met before addition to the fixing ammonia.

The Cupro-Chloramine process for algæ control seemed more successful than copper or chloramine alone for some conditions. The explanation for such seemed to reside in the fact that the copper remained in soluble condition longer.

John Gettrust, Engineer of Pumping and Filtration, Akron, Ohio, in a prepared discussion, emphasized the value and impressiveness of the work toward improving fusible plugs. Some years ago he had learned in the school of experience that block-tin pipe was *not* the material for resisting chlorine attack. (For the same reason tin-base solder is no good for making up sweat joints in a chlorine line of copper tubing, whereas silver solder meets all requirements.—Ed.)

Mr. Gettrust described the Akron method of employing one-ton chlorine containers and the nicety of but one-thirteenth the number of connections as required to connect up thirteen 150-lb. cylinders of chlorine. The economy of ton containers was all the more impressive when employing chlorine to aid coagulation or produce chlorinated-iron (tower method) or chlorinated ferrous sulphate. As a safety measure, making permissive the use of chlorine from a leaking ton container, Mr. Gettrust suggested the sealed emergency vault for ton-containers as installed at one of the New York stations and described in WATER WORKS & SEWERAGE for December, 1938, by H. G. Shockley, designer. To prevent accidents, Mr. Gettrust emphasized the value of operator instructions and respect for the axiom that "familiarity breeds contempt." It too frequently breeds carelessness, because of the few accidents experienced with chlorine.

Round Table

(Professor Geo. E. Barnes, Presiding)

Under Prof. Barnes a number of interesting topics were discussed in the "Round Table Period"—the limit rule being 12 minute presentation and 3 minute discussions.

"Service Materials"—Introduced by *Paul Cook,* Sanitary Engineer of Lake County, Painesville, Ohio.

Mr. Cook, a member of A. W. W. A.'s Committee on Service Line Materials, cited the merits and advantages of pure copper flexible tubing and stated the fact that the hazard of lead poisoning required preliminary investigation before its safe use could be assured. He pointed out that red-brass pipe was even more resistant to corrosive waters

"Sid" E. Linderman, Pittsburgh (Distr. Mgr., U. S. Pipe & Foundry Co.); Carl Eberling, Cincinnati (Sup't. and Engineer of Water); E. E. Harper, Kansas City (President, Omega Mfg. Co.)

than pure copper tubing. A note of warning was sounded concerning the production of an electrolytic couple and corrosion intensification at points of contact between two dissimilar metals, such for instance, as copper and lead or brass and iron. While the zinc linings from galvanized pipes and boilers were frequently dissolved away, nothing in the way of a health hazard had been shown by the history of those drinking "zinc cocktails". Mr. Cook concluded that there could be no blanket recommendation made and, in selecting service pipe, local conditions must continue to rule.

L. H. ENSLOW, commented that, but for the exceptional condition, there was nothing to be gained in installing red brass pipes in preference to the simpler and less costly copper tubing. In very soft waters and some mineralized waters red-brass had been proven more resistant but for the moderately corrosive waters of the mid-west the advantage disappeared.

"Taste and Odor Problems"—Introduced by J. A. MARSH, Chemist in Charge, Baldwin Filters, Cleveland, Ohio. He stated that continuous application of carbon to the raw water had proved a safety measure in stopping the unexpected taste troubles. With such routine application odors around the plant had improved perceptably, and he advocated the practice to keep the basins and filters "conditioned" at all times. The scheme might be referred to as that of providing a "taste and odor barrier".

PHILIP BURGES, Consulting Engineer, Columbus, Ohio, commented on experiences at Beaver Falls, where the odor threshold number of 1000 had required excessive carbon dosages, adding $15,000 to $17,000 annually to the cost of treatment.

"Meters and Metering"—Introduced by PAUL COOK, Sanitary Engineer, Lake County, Painesville, Ohio. He reviewed existing A. W. W. A. Meter Specifications, unchanged since 1921 and calling for only 90% registration on ¼ g.p.m. flows through ⅝ in. meters. As a matter of fact, the average registration for 11 makes of new meters at ¼ g.p.m. flows is practically 98% of the flow. Just to emphasize the need for specifications to cover the meter of today, Mr. Cook pointed out that a 7% under registration of all water metered would cost American water utilities better than 37 million dollars annually. Thus is seen the importance of the monster—"Unaccounted for Water".

"Interior Coatings for Steel Tanks"—Introduced by L. J. HOFFMAN, Engineer, Water Dept. of Akron, Ohio. He revealed Akron's experiences with coatings for tank interiors over a period of several years. In placing contracts a bond for 7-year period is demanded of the successful bidder supplying the material and applying the coating to new or old tanks. The recent contract went to W. A. Briggs Bitumen Company of Philadelphia, who supplied tar-base enamel with sag test between 400 and 500°F., applied by hand brushing to provide a coating not less than 1/16th inch thickness at all points.

"Cathodic Protection of Tanks and Standpipes" was described by W. W. Morehouse, of Dayton, the protective equipment having been installed by The Electro Rustproofing Company of Dayton. The scheme involves the application of electric current through one or more suspended electrodes in the water. From the electrode the current radiates to all unprotected metal areas and reverses the flow of current set up by electrolysis or corrosion. Mr. Morehouse, in stating that the bare spots seemed to be coated with a grey powder, believed that it was possibly a case of deposition of calcium by the plating process.

"External Pitting of Cast Iron Pipes"—Introduced by C. E. INMAN, Supt. of Water at Warren, Ohio, was a revelation of experiences with soil corrosion and pitting of DeLavaud centrifugal cast iron pipe laid in clay soil in 1921. Mr. Inman showed specimens of the attacked pipe and revealed that the trouble was peculiar to the centrifugal pipe, whereas 51-year-old pit-cast pipes had been found in excellent condition as had some 28-year-old pipe. No one had any suggested reason for the comparative behavior of the pit vs. centrifugal cast pipe of 1921, the earliest produced by the then new method of casting pipes.

The 1940 meeting of the Section will be held in Akron, Ohio.

Now get SOFT...IRON-FREE CITY WATER *this new, economical way*

Investigate Permutit Spaulding Precipitator...NOW!

Perhaps you have often wished that your city could have soft, iron-free water. Then you will be interested in this latest development by Permutit—a radical advance in cold lime treatment.

It is Permutit's Spaulding Precipitator! It takes less space and uses less chemicals. The water is softer and more stable. Operation is simpler—requires less attention. Within the last few months, more than a score of these plants have been installed for municipalities, treating water supplies between 5000 gallons and 8,000,000 gallons per day.

The whole story is in the booklet pictured above. In its clear, fully illustrated sixteen pages you will find all pertinent facts of interest to you and your engineering staff.

And remember, the Spaulding Precipitator is made by Permutit—water conditioning headquarters! It is a companion product to the famous Permutit Automatic Zeolite Water Softener and Automatic Filter. For information on any of these products, write to The Permutit Company, Dept. G1, 330 West 42nd Street, New York, N. Y.

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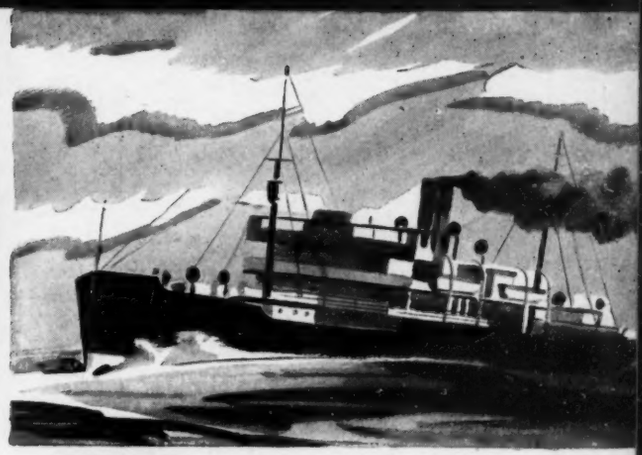
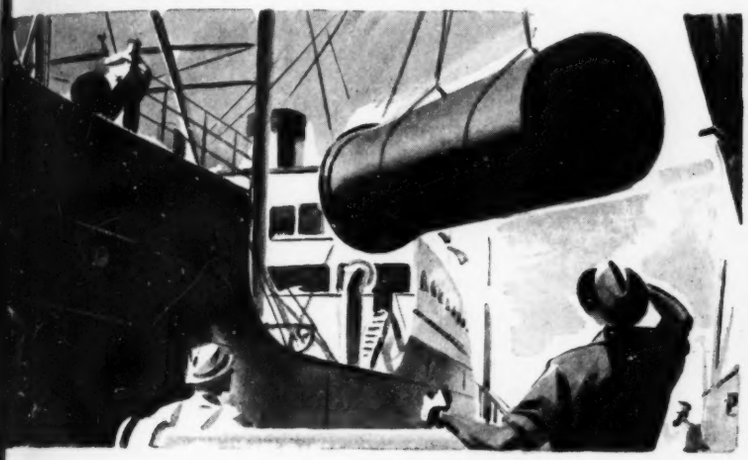
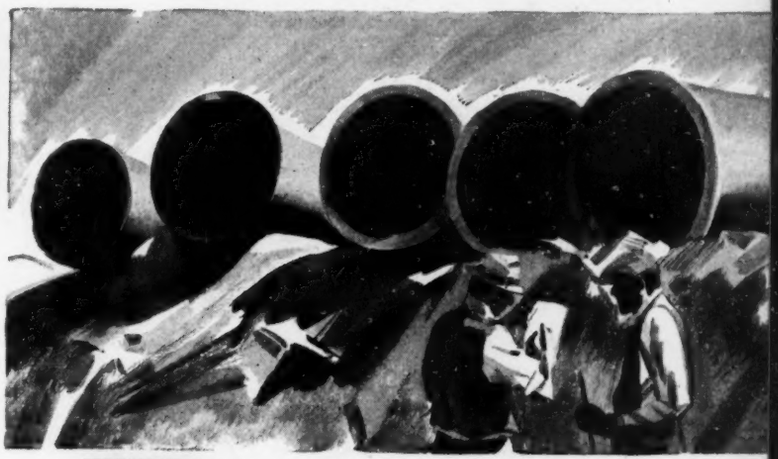
Our story begins with the installation of a 48-inch cast iron water main under North Broad Street, Philadelphia, in 1901. After 24 years of service, the construction of the Broad Street Subway required its removal. The pipe was salvaged, reconditioned and placed on sale for service not requiring A.W.W.A. wall thickness.



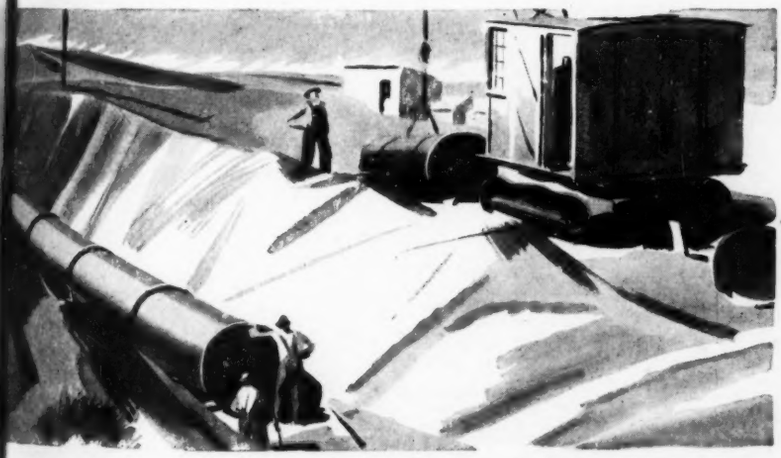
Now our pipe is en route from Philadelphia to Los Angeles, 4866 nautical miles away, bought for the City of Glendale, California, to be used for an intercepting sewer river crossing under the Los Angeles River.



Here you see it being unloaded at Los Angeles for delivery to the job at Glendale, where it was laid for the *second time*. Sold at a saving over the cost of new pipe yet having realized a good salvage value for Philadelphia, both cities benefitted.



Thirteen years later a Flood Control program required deepening the Los Angeles River channel, involving relocation of the Glendale intercepting sewer. It was found economical to uncover this 48-inch cast iron line and remove it for reinstallation.

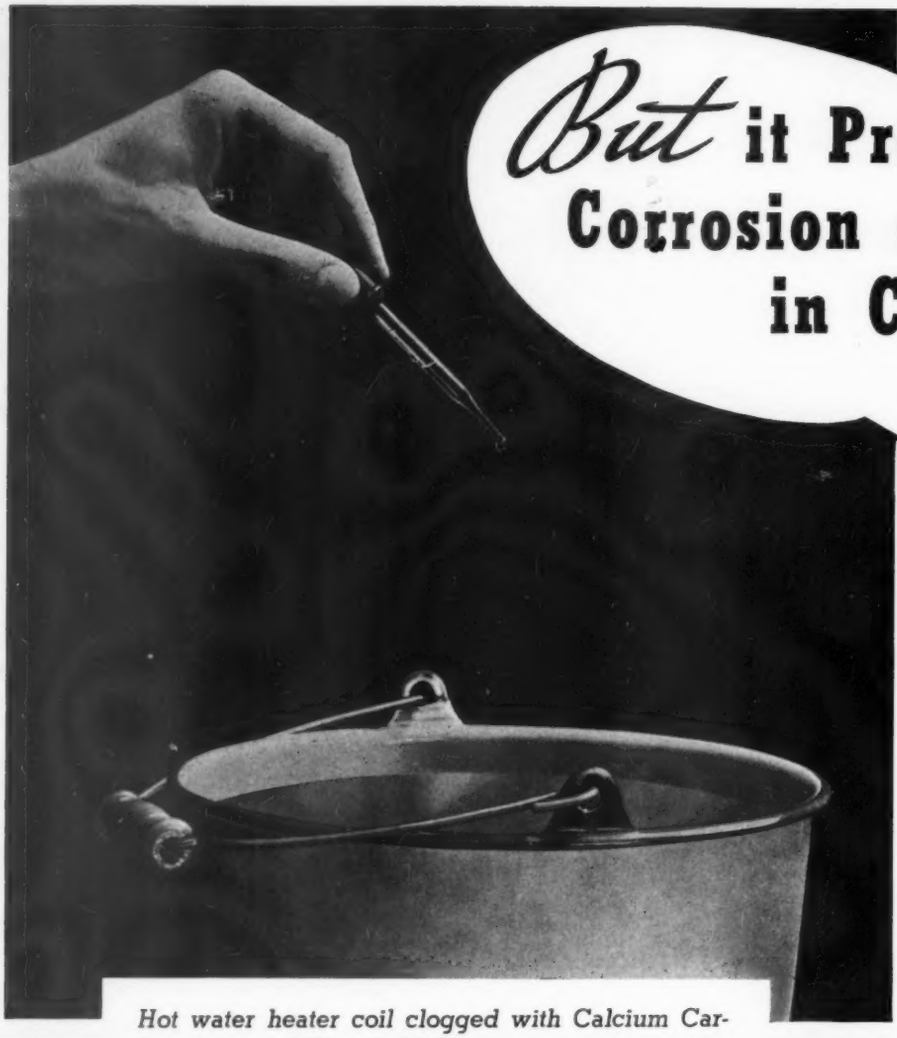


Here our pipe is starting out on its *third life*, after 24 years of service at Philadelphia and 13 years of service in its first location at Glendale. Barring unforeseen circumstances, this cast iron pipe line will serve for a century or more in its present location.

THIS STORY of the adventures of a 48-inch pipe line is a striking example of the salvage value of cast iron pipe. The recognized standard material for underground mains, cast iron pipe is also unequalled for long life and low maintenance cost, justifying its reputation as Public Tax Saver No. 1.

Look for the "Q-Check" Registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.

Only a Drop in the Bucket!



But it Prevents Corrosion and Scale in City Water Systems

Hot water heater coil clogged with Calcium Carbonate scale! Threshold Treatment prevents this!

THIS remarkable new product is called Calgon. It's so effective that as little as one part in a million prevents corrosion caused from naturally soft water, and, where softening plants are in use, Calgon also stops the encrustation of filter sands and after-precipitation in the distribution system. Where hard water is used, Calgon prevents the formation of calcium carbonate scale in hot water lines and heater coils. It's almost unbelievable that these age-old problems can be solved so easily but the facts have been definitely established in actual practice. This method is called Threshold Treatment.

Only small amounts of Calgon are needed — one or two pounds are sufficient for 100,000 gallons of water. No elaborate dosing equipment is necessary, so the cost of Threshold Treatment is always low.

For more information write to Calgon, Inc., 300 Ross St., Pittsburgh, Pa., or see the January, 1939, issue of Water Works and Sewerage and the January, 1939, issue of Industrial & Engineering Chemistry.

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Arizona Sewage and Water Works Association Holds Annual Meeting in Phoenix

Reported by A. M. RAWN*
Associate Editor
LOS ANGELES, CALIFORNIA

Granite Reef Dam—Salt River Irrigation Project

FEATURING water supply at the technical sessions of its thirteenth annual convention, the Arizona Sewage and Water Works Association joined forces with the Arizona Public Health Association at Phoenix on May 5 and 6 to participate in the most successful meeting in its short but effective history. [The waterworks men were included in membership of the Sewage Works Association at the annual convention of the latter in Tucson last year.]

On Friday, May 5, the group met in general session with the Public Health Association. Papers presented at the Friday meeting covered a wide variety of public health topics, but among them were two of especial interest to members of the Sewage and Water Works Association; viz., R. F. Goudey's able discussion of open reservoir protection and distributing main cleanliness, and a paper by A. M. Rawn relating to public health hazards in the use of sewage water for crop culture.

The Association convened at 9 A. M. on Saturday, May 6th, for its separate technical sessions. Presentation of eight papers consumed the morning. Following luncheon, Goudey was again prevailed upon to review his discussion of the previous day and show pictures illustrating his remarks. The group then met in round table session from two until five, discussed the facts presented during the morning session, as well as other problems perplexing the members, and upon which discussion was appropriate. The meeting concluded at the close of the round table with election of officers. Phil J. Martin, Superintendent of Tucson Water Department, was elected president for 1939-40 and F. C. Roberts, Jr., State Sanitary Engineer, secretary-treasurer. The fall convention meeting place is tentatively set at Winslow, Arizona.

*Ass't. Chief Engineer, Sanitation Districts of Los Angeles County.

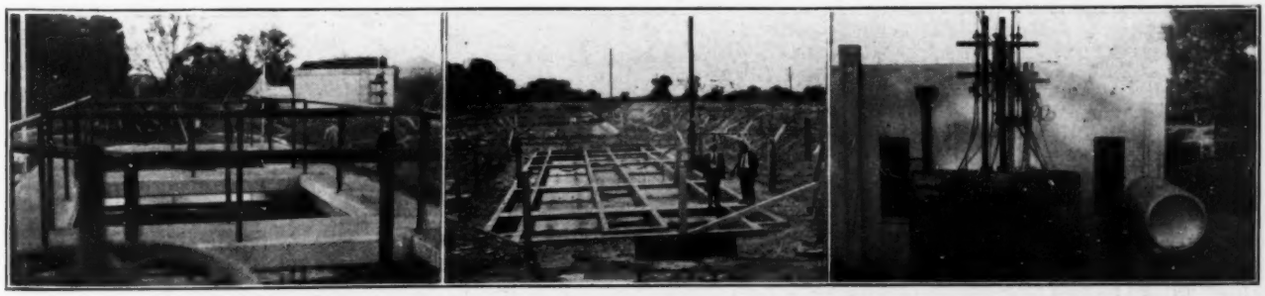
Papers and Discussions

"Protection of Domestic Water Supplies," by R. F. Goudey, Sanitary Engineer, Los Angeles Water Department.

After discussing the types of marine life and algæ which plague a water supply reservoir, Goudey described an ultra-violet ray meter which daily integrates the violet ray units in the daylight at the reservoir site. The maximum activity in algæ growths is concurrent with maximum violet ray presence. Such is the case during the spring weeks. By keeping watch on the violet ray charts the Los Angeles Water Department has been able to control algæ by killing it during its most active period of reproduction. Many and varied machines have been devised for broadcasting pulverized $CuSO_4$, each a little better than its predecessor, until now it is possible to do in a few hours what formerly took a couple of weeks. Goudey stated that for effective sterilization the application of less chlorine than that to satisfy chlorine demand was useless; and, that residual chlorine machines for exact dosage control were not only desirable and necessary but had proved highly economical in the long run.

"Revised Procedure of Monthly Water Samples Reporting" by George Marx, District Engineer, Arizona State Board of Health, Tucson, Arizona.

Mr. Marx told of Health Board efforts to stimulate interest in the Board's analysis of water supplies. He stated that prior to 1938, a yearly summary of analyses was mailed to each owner without comment; but that beginning in April, 1938, the Department adopted a policy of reporting results of analyses immediately and then furnishing a monthly summary with comments, commending or criticising tactics and results. Mr. Marx concluded from the fact that an increasing number of sam-



(1) Precipitation Tanks and Digester—Wickenburg, Ariz.; (2) Tempe, Ariz., Boasts New Imhoff Tanks and Dunbar Beds; (3) At Wickenburg, the Iron Chloride Generators

ples were being submitted, that public interest was waxing and stated that benefits were resulting in public water quality.

"The New Sewage Treatment Plant of Tempe," by E. Daley, City Manager, Tempe, Arizona.

At a cost of $65,000 the city of Tempe (3000 pop.) has constructed in the Salt River Wash below the town, an Imhoff tank 22x27 ft. in plan and 19 ft. deep; and three Dunbar filter beds, each 100x112 feet in plan and 5 feet in depth. Effluent from the Imhoff tank is run onto one bed for ten days; switched then to another, and so on, allowing ten days use and twenty days rest per bed per month. The treatment works were placed in operation March 9, last, and operating data are too meager to indicate trends. Effluent from the beds is discharged to the Salt River, and in general appearance is excellent.

"Santa Fe Railroad Water Development," by George L. Davenport, Jr., Assistant Engineer, A. T. & S. F. Ry.

Mr. Davenport remarked that the recent changes to Diesel engine motive power had had but little effect upon the water needs of the Santa Fe railroad west of Albuquerque. While the requirements have been slightly reduced, most of the water is, as in the past, utilized in cooling, in stationary plants, and for water supplies other than boiler feed water. It is impossible to enumerate in the brief review of Mr. Davenport's paper the statistical data presented. However, one's conclusion after hearing his discussion is that the location of a railroad in western United States is not so much a problem of finding a place to put the railroad, as it is of finding water with which to operate it. Since 1898 the railroad company has been constantly on the alert to improve its water supplies in the high, dry country extending from Albuquerque to Needles. Mr. Davenport said that about forty years ago the railroad employed a U. S. G. S. geologist to make a water survey along its route and that this report, completed in 1902, continues of great value as a guide in developing new well supplies. He concluded by stating that water requirements for the Santa Fe west of Albuquerque were about 9½ million gallons daily, of which 3½ M.G.D. were treated for boiler feed.

(Left)—Dario Travoini, Supt. Sewage Works, and P. E. Mauzey, City Health Dept., Phoenix, Arix. (Center)—R. F. Goudey, San. Engr., Water Dept. of Los Angeles, and A. A. Weiland, Cons. Engr., Pueblo, Colorado. (Right)—Ed. Waggoner, Pacific Clay Products, and Alice Mathis, Chemist, Phoenix Sewage Plant

"Amongst Those Present"

A. L. Frick, John Corrolo, Rex Elmore, Robert Cushing, H. C. Pierson, Geo. Marx and Carlyle Roberts, new Secretary of the Association.

"The New Water Supply of Safford," by C. A. Rhoads, Superintendent, Safford, Arizona.

Rhoads introduced his topic by a quotation from Pliny to the effect that "Of all things, water is best; water is life." He then briefly reviewed ancient, historic water supplies, discussed the situation in southern Arizona, and launched into a description of the Safford problem. He said that prior to 1911 the Safford supply had been secured from surface wells, but that this water was so hard as to be decidedly unsatisfactory. A few years later a pipe line was extended four or five miles to Mt. Graham, where some soft water was available which, unfortunately, was subject to objectionable odors and tastes during certain seasons of the year. In 1933 an investigation of nearby water sources disclosed the most satisfactory supply to be at Bonita Canyon Springs, twenty-one miles from town. At the cost of half a million dollars, Safford (with a population of only 7000) constructed infiltration galleries at the Bonita Springs, ran a 10" and 12" cast iron pipe line to the town of Safford, and constructed an elevated storage tank in town. Among the unique features in the construction of the 21-mile supply line is a 700-ft. span suspension bridge across the Gila river, supporting a 10¾" O-D steel pipe jointed with flexible couplings. The elevated storage tank is 125 feet in height. P. W. A. furnished 45% of the construction funds and bought the Revenue Bonds for the remainder.

"Tucson Water Department Improvements," by Phil J. Martin, Supt. of Water; L. R. Burch, Designing Engineer; and Rex Elmore, Construction Engineer, Tucson, Ariz.

Mr. Martin stated that Tucson, in 1932 found itself in the position of many cities throughout the United States, when called upon to present plans for a new water distribution system to be placed ahead of a revised and reconstructed street layout proposed under the then existing C.W.A. He said that hasty efforts were made, taking long guesses as to population movements and concentration, which so far have been surprisingly accurate. More recently, stimulated by P.W.A. loans and grants, the city has still further revised and extended its storage facilities and distribution lines.

Mr. Burch, describing new construction, stated that lines were tested at 200 lbs. per sq. in. and that most failures occurred at carelessly adjusted fittings; no pipe failures occurred. Pipes were coated with bituminous cover and tested electrically for thickness of covering. He stated that new mains were disin-

fected for as long a period as they could be taken out of service, usually twelve hours, with water containing 50 p.p.m. of chlorine. Extensive tests by insurance underwriters indicate a 56% better fire hydrant service in residential areas and 70% in the business district have resulted from the betterment.

According to Mr. Elmore, in 1933 under C.W.A., the city began construction of a surface reservoir, the embankment of which was finally completed and included in the 1938 program as foundation for the cantilever wall of a new reservoir. Describing the reservoir, Mr. Elmore said that the 205x208-ft. reservoir roof is supported by 103 reinforced concrete columns, each 25 feet in length and 9 inches square. Side slopes and reservoir floor are covered with 2¼ inches of Gunite, applied on expanded reinforcing mesh. The cantilever wall surrounding the reservoir and supporting the roof edges is broken into 30 and 60-ft. lengths, with joints sealed with copper flashing. Joints between column footings and floor are filled with a synthetic rubber compound. The reservoir capacity is 8½ million gallons.

"Public Health Hazards in the Use of Sewage for Crop Culture," by A. M. Rawn, Assistant Chief Engineer, Los Angeles County Sanitation Districts.

The speaker briefly described the magnitude of the problem in the West, stating that, eliminating sewage of seaboard cities and those in non-irrigated sections, there remained some 300 m.g.d. of sewage available for irrigation—of which two-thirds either reaches streams or ground water and is reused in whole or part or is applied directly to the soil in sewage farming. Rawn then compared State Health measures pertaining to sewage irrigation, showed the wide differences in authority, touched upon the possibility of disease transmission by crop contamination, and concluded by stating that irrigation with sewage in the arid West has served the purpose of sewage disposal well, but is now dying out with the advent of new and better ways of sewage treatment.

[The next meeting of the Association is scheduled for Winslow, Ariz., some time in the Fall.]

GALLONS IN WATER SUPPLY PIPE*

Water supply men often want to know the volume of a given length of pipe in gallons. This writer does not know of any table that gives such values and where volumes are to be found they are usually given in cubic feet. Besides, the range of a table is seldom great enough to cover all desired conditions.

This chart takes care of all standard pipe sizes from ⅛ inch to 15 inches on scale A, and any length of pipe line from 0.1 foot to 800,000 feet on scale B. Scale C shows volumes from 1 to 1,000 gallons.

In using the chart simply run a straight line through the pipe size (column A) and the length of pipe line (column B) and the intersection with column C immediately gives the total number of gallons in the pipe or pipe line.

Thus the dotted line drawn across this chart shows that if the pipe size is 2½ inches (column A) and the length of line is 400 feet (column B) the volume of the pipe (column C), is 100 gallons.

For a length of pipe which is found to hold more than 1,000 gals. the volume is readily found for 1/10th or 1/100th of the length and the C scale reading multiplied accordingly.

Or, if it is desired to know the length of pipe line required to hold a given number of gallons, or the size of the pipe necessary to hold a given number of gallons within certain limitations of length, the chart may be conveniently applied. In other words, knowing two factors in any two of the three columns, the unknown in the third column is quickly found.

Here is another "trick": To determine the volume of a ½-inch pipe one foot long, the easiest way is to run a line through the ½-inch, column A, and the 10,000 in column B. The intersection with column C says 160 gallons, but that, of course, is for a pipe line 10,000 ft. long. By merely pointing off four places to the left we have 0.016 gal. as the volume of a ½-inch pipe one foot long.

*Contributed by W. F. Schaphorst (M.E.), Newark, N. J.

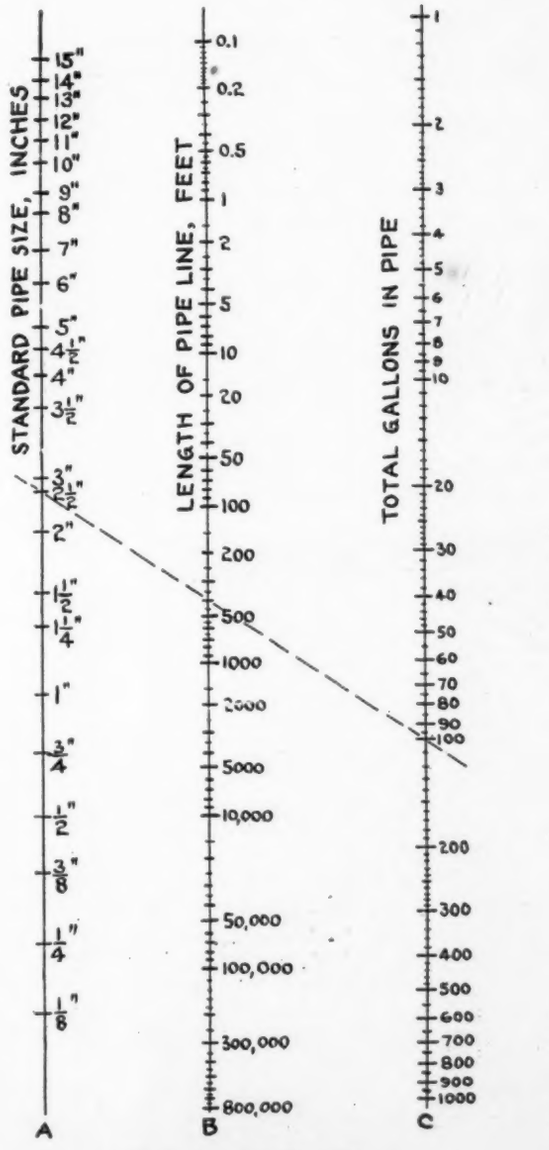
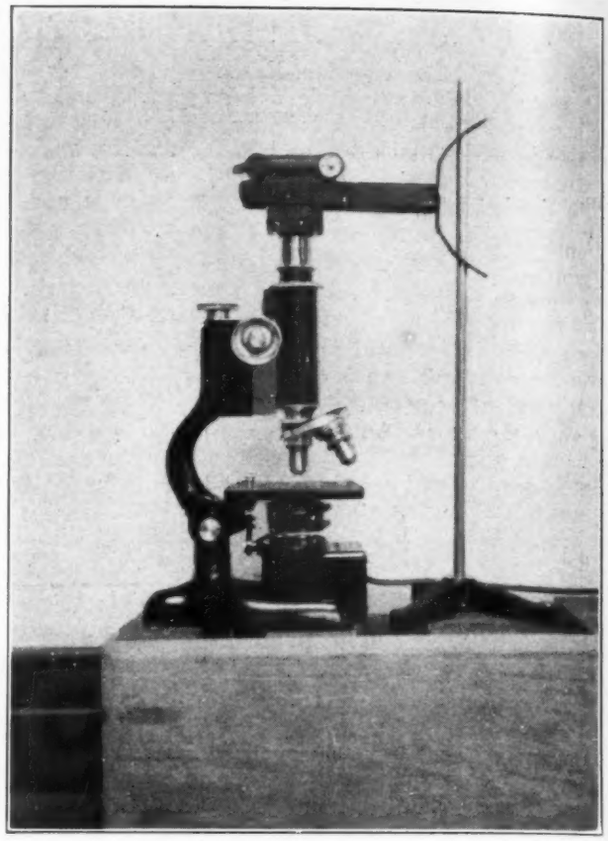


Chart Size of Pipe Size, Length and Capacity

PHOTOGRAPHING MICROSCOPIC ORGANISMS

By FRED E. SMITH, Chemist
Water Department
CAMBRIDGE, MASS.



Apparatus

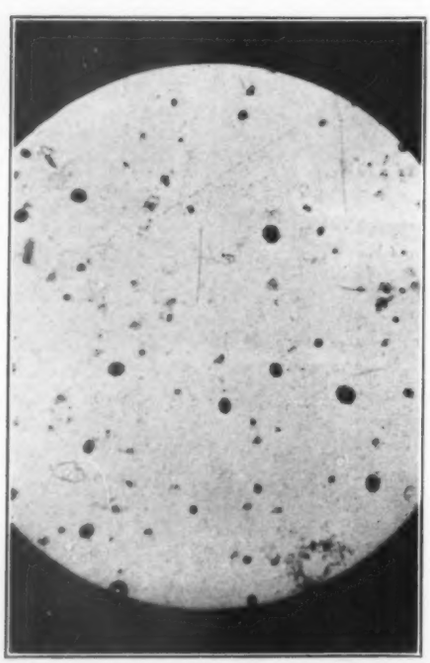
IN the routine examination of reservoir samples at the Cambridge filtration plant, many different species of plankton growths have been observed with the microscope. Often a photographic record of microscopic organisms would be worth-while; but the cost of standard photographic equipment for microscopic work is relatively high; and such apparatus is not as a rule considered a necessary part of the equipment provided in water works laboratories for routine examinations.

An Inexpensive Apparatus—

An inexpensive apparatus has been obtained, with which photographs of microscopic organisms have been taken successfully. Fig. 1 illustrates its arrangement. It consists of the microscope, for which illumination is provided by a standard lamp fitted with blue glass and placed in the position normally occupied by the microscope mirror. The camera is a "Univex," Model A, which has been adjusted for time-exposures. Camera and stand cost only two dollars.

Procedure with this apparatus is not difficult. The water sample is filtered in the usual manner by the Sedgwick-Rafter method, and the organisms collected on the sand are removed with a small volume of water. One ml. is pipetted into a Sedgwick-Rafter cell and the cell contents are then examined with the microscope. A magnification of 100 is satisfactory.

When a field is observed, containing organisms of which photographs are desired, the camera is placed on the stand. It is extremely important that the lens opening of the camera be accurately aligned with the eyepiece of the microscope and a little practice may be required for this step. Careful manipulation is necessary while the picture is being taken, so that the camera position will not be changed and the setting



Asterionella, Melosira, and Pandorina

Daphnia

of the microscope will not be disturbed. It has been noted in this laboratory that an exposure of 7 seconds is satisfactory.

Larger types of microscopic organisms such as protozoa and crustacea may require the addition of a small quantity of chloroform to the liquid in the cell in order to kill them. These species of aquatic life are often in movement and connot be photograped easily unless killed.

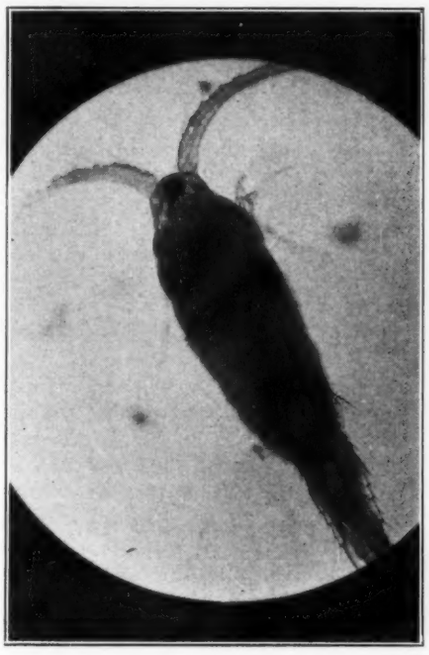
Results—

Figs. 2, 3, 4 and 5 illustrate enlarged photographs of microscopic organisms obtained by means of the method outlined. Fig. 2 shows Asterionella, Melosira and Pandorina: an example of a field containing more than one kind of smaller organisms. Fig. 3 is a picture of Daphnia. Fig. 4 is a photograph of Cyclops, another crustacean. This organism is microscopic in size. It was removed with a small pipette from a bottle of raw water and placed on a watch glass in a small volume of water; a drop of chloroform was added and the photograph taken. Fig. 5 is a photograph of an "unknown." It is believed to be an egg cell of an unidentified form of aquatic life.

Photographs of bacteriological preparations have also been taken with this camera. For this work the oil-immersion objective is used, and the magnification is approximately 1000. Slides may be prepared by staining with crystal violet, washing and drying. The slides prepared for the Gram stain examination may also be used for photographs. The procedure used to obtain this type of photograph is similar to that previously described. Fig. 6 shows bacteria photographed with this camera.

The views of microscopic organisms and bacteria here presented show that photographs of fair quality may be obtained with this low-cost apparatus. Films cost ten cents per roll of six exposures. The photographs produced are 1¼ inches on a side, and the cost of developing is nominal. Prints may be readily enlarged to a convenient size—3x4½ inches. The technique of manipulating microscope and camera is very simple. The photographs have proved to be useful in lectures and demonstrations given to school and college groups visiting the Cambridge Filtration Plant.

To the water works chemist whose hobby is photography, a most interesting field of endeavor is made available with the equipment here described. The same equipment has been used successfully to photograph crystalline preparations involved in the procedures of microchemical analysis.



Cyclops

"Unknown"

Bacteria

NEW YORK'S E. J. FORT RETIRES

Edwin John Fort

(Snapped at the dedication of his World's Fair Plant)

Upon completion of the new Tallmans Island Sewage Treatment Works — known as the N. Y. World's Fair Plant — Edwin J. Fort, Project Engineer of the Department of Public Works retired June 1st. He was given a testimonial luncheon by his colleagues and officials of the Department.

Mr. Fort—now 71 years young—has to his credit a distinguished career in municipal engineering. He was at one time Chief Engineer, Bureau of Sewers, for Brooklyn, N. Y. He later served as Executive Engineer of Ridgewood, N. J.; General Supervisor of Englewood, N. J.; and City Manager of Niagara Falls, N. Y. Since 1931 he has been continuously connected with the New York Department of Sanitation, which later became the Department of Public Works.

Mr. Fort will, after a vacation, engage in consulting work in connection with sewage disposal.

STEEL SEWAGE FORCE MAIN FOR SAUGUS, MASS.

In its P.W.A. sewage disposal project Saugus, Mass., has under construction a pressure outfall main of bituminous protected steel pipes, jointed with flexible Dresser Couplings. The main is constructed of 22 in. (O.D.) pipes supplied by National Tube Co.; the protective coating and lining being that of Hill-Hubbell & Co. The engineers are Fay, Spofford and Thorndike of Boston. The operating pressure will be 80 lbs. at the pumping station.

PURGING DIFFUSER PLATES WITH CHLORINE

An Economical Method of Cleaning Plates While Still in Operation

The Author

By W. M. FRANKLIN
Superintendent
Water and Sewage Plant
CHARLOTTE, NORTH CAROLINA

THE five aeration units at the Irwin Creek Sewage Treatment Plant, at Charlotte, N. C., are of the ridge and furrow type, equipped with diffuser plates. This plant was placed in operation in 1927. Air is supplied by General Electric single stage high speed blowers. Each aeration unit has a designed capacity of one million gallons per day, with four hours retention. Manometers register the cubic feet of air per minute being delivered to each aeration unit. A master air-meter records the output of the blower or blowers—i.e., the total quantity of air applied.

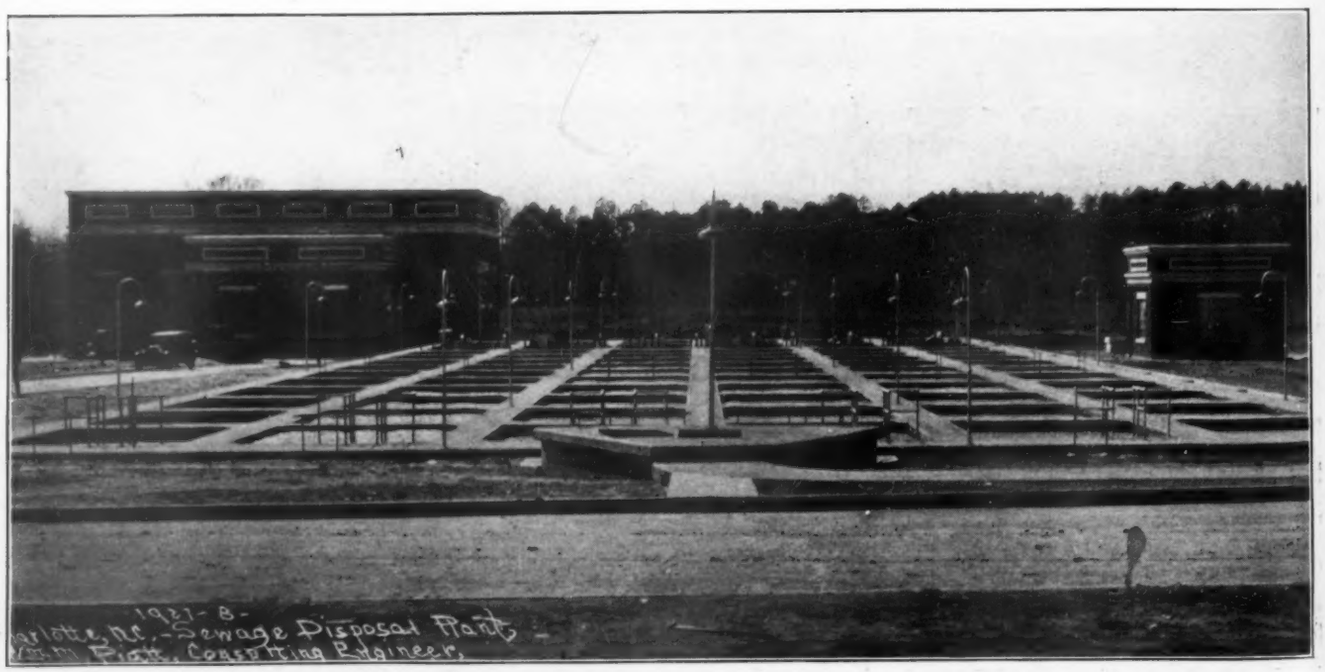
Cloggage Troubles

In the early summer of 1938 the diffuser plates in all the units became so badly clogged that it was impossible, even with two blowers in service, to get enough air thru them to maintain proper aeration. All units were then cleaned out, as rapidly as they could be spared from service, and the diffuser plates scrubbed with muriatic acid. This had been the practice since the beginning of plant operation. All but two of the units responded reasonably well to this treatment. Units, No. 1 and No. 5, became clogged again after a few weeks operation. The acid cleaning was repeated in these two but with no better success. The normal average delivery of air per unit with one blower in operation is about 700 to 750 cubic feet per minute. The delivery of the diffusers in No. 5 unit was down to an average of 450 ft. with one blower in service, and with two blowers in parallel an average of 750 ft. could be maintained—(see Fig. 1). Since it was impossible to increase the air delivery in these two units by throttling the other three and thus increasing the pressure of the air in the header feeding the diffusers we were in (what would be called in modern language) "a mess."

With the centrifugal blowers operating in parallel, or singly, there is practically no pressure variation except that caused by changes in atmospheric conditions. Even if it had been feasible to build up the pressure in the air lines to a point considerably above the 7.5 to 8.0 lbs. normal operating pressure, this expedient would be uneconomical. Previous experience had proved that the scrubbing with acid followed by several days of air and sun drying was the next best thing to try. At this time the plant load was heavy and the removal of one unit from service for a period long enough to try this plan was extremely hazardous.

We Decided to Try Chlorine

We decided to follow a suggestion previously made by L. H. Enslow of the Chlorine Institute. This suggestion was to add chlorine (as



Aeration Tanks—Irwin Creek Treatment Plant, Charlotte, North Carolina (Wm. M. Piatt, Designing Engr.)

gas) to the air headers leading to the diffusers, with the idea that the chlorine would destroy algae growth in the plates, and might combine with the moisture at the plate surface to form hydrochlorous acid which in turn would dissolve materials clogging the pores of the diffuser.

We first viewed this plan with alarm, fearing that the presence of chlorine gas in the air lines might cause corrosion, especially in the small feeder lines. Finally it was decided to try chlorine anyway. We first fed chlorine, by means of a dry feeder, thru a standard corporation cock and diffuser into the main air header leading to all the units. This did not prove successful due to the fact that the capacity of the feeder was not large enough. A tap was then made in the header feeding No. 5 unit and chlorine fed into the air flow at the full capacity of the machine, which proved later to be about 17 lbs. per day.

In Fig. 1 you will note that the delivery of the diffusers in No. 5 aeration unit, in cubic feet of air per minute, has been plotted from August 22, 1938, thru Oct. 9, 1938. Dotted lines indicate the period during which two blowers were operating in parallel, the solid lines indicating the period during which only one blower was in operation. Note that on Sept. 15 chlorine was fed for about four hours at the 17 lb. per day rate with two blowers operating. After the chlorine was cut off the two blowers remained in service the 18th. At this time one blower was removed from service and on the 19th the chlorine application was continued until the 150 lb. cylinder was exhausted on Sept. 25. The second blower was put on the line on the 24th with the idea that the increased velocity thru the plates might help in opening up the pores. On the 30th normal operation was resumed with one blower.

Note the increase in air delivery during the period following the first "shot" of chlorine until the end of the curve on Oct. 9.

Results

Actually, the chlorine brought about an increase of approximately 66% in air delivery with one blower in service and 53% with two blowers in service, as is shown by the curve. Needless to say we were so well pleased with the results that we immediately cleaned No. 1 unit with one cylinder of chlorine getting equally as gratifying results as was the case in the No. 5 unit.

At this date March 1, 1939, the air delivery of the diffusers in both Unit No. 5 and Unit No. 1 is about 750 cubic feet per minute and no detrimental effects from the application of chlorine have been observed.

It is possible that the extreme clogging of the diffusers was primarily due to the presence of large quantities of brewery wastes in the sewage. It is our theory that the action of the chlorine not only cleaned the surface of the diffuser plate but also cleaned the pores *from the inside out,* removing organic matter from interior pores of the plate which could only otherwise be removed by a heat treatment, or long soaking in an acid bath.

We wish to thank Linn Enslow for his timely suggestions, E. L. Nance, Chief Operator at the Irwin Creek Plant, and his assistants who aided in the work. We also wish to acknowledge the loan of the chlorinator by Wallace & Tiernan, through their representative, H. F. Davis.

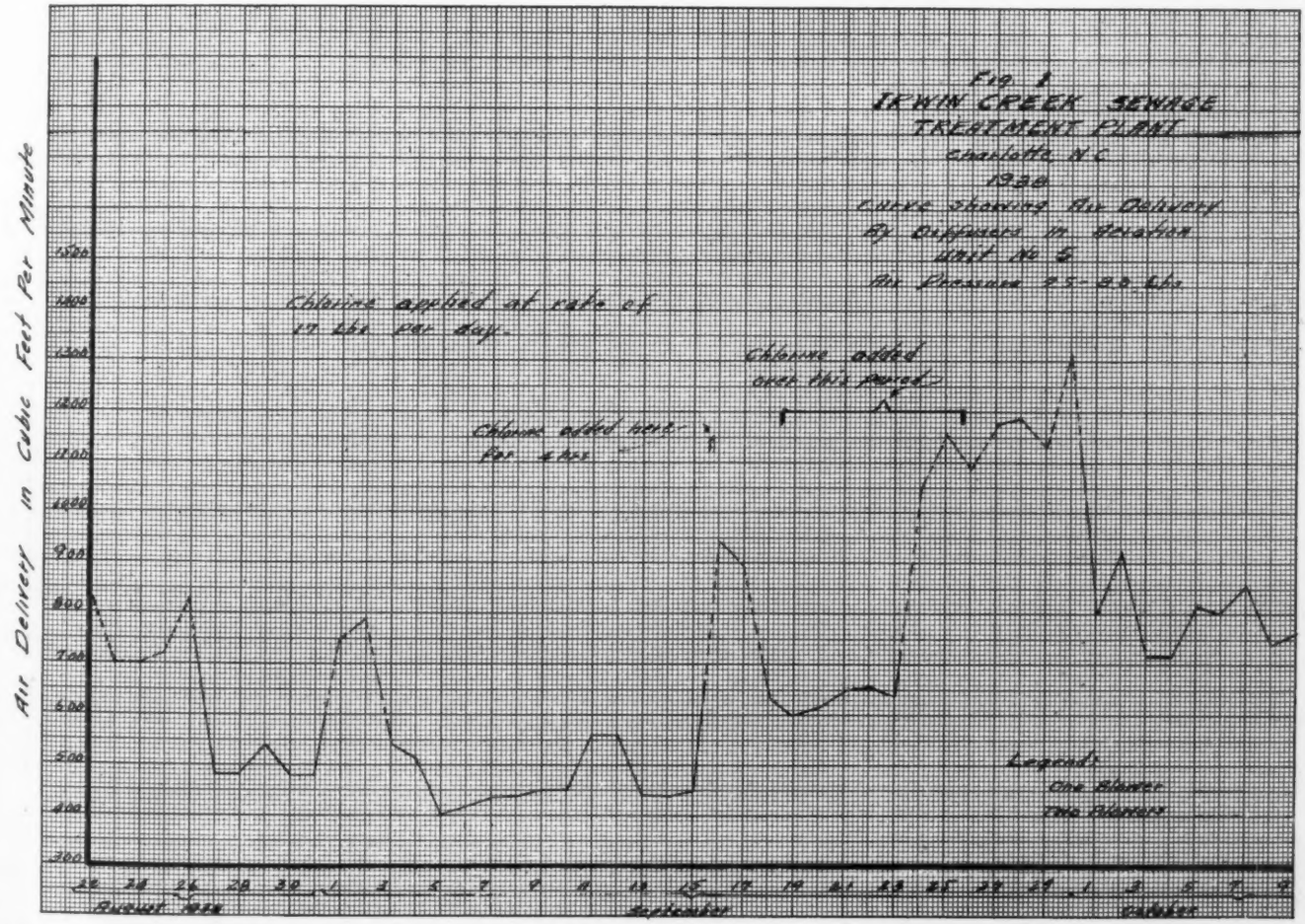


Fig. 1—Graph Showing Change in Air Delivery Before and After Treatment of Plates With Chlorine Gas, in Situ

SLUDGE FILTRATION

*Sludge Conditioning**

[*The Second Article in a Series*]

By LeROY W. VAN KLEECK

Senior San. Engineer, Connecticut State Department of Health
HARTFORD, CONN.

IF sludge could be dewatered on vacuum filters without the use of conditioning chemicals, the filter perator would have a comparatively easy job. However, sludge conditioning with chemicals is *the* important step in sludge filtration and it is only when properly prepared sludge is delivered to filters that they perform successfully. Many factors affect conditioning.

Raw primary, raw activated, raw chemically-precipitated, semi-digested and digested sludges may be successfully filtered. Secondary settling tank sludge (humus sludge) may also be filtered with raw or digested sludges, preferably after digestion[1]. As a rule, raw primary, raw chemically-precipitated, semi-digested and digested sludges are conditioned with both ferric chloride and lime, sufficient to produce distinctly alkaline reaction. Occasionally ferric chloride is used alone but this invariably requires considerably more ferric chloride than would be needed if combined with lime. Since lime is by far the cheaper chemical, a combination of lime and ferric chloride generally proves the most economical. Raw activated and elutriated raw or digested sludges (usually the latter) are most economically conditioned with ferric chloride alone.

For this issue we had scheduled the third article of a series by Mr. Van Kleeck on "Sludge Filtration," which deals with equipment and practices in sludge dewatering on vacuum filters. The author presents information of benefit to the designing engineer, the purchaser and the plant operator.

In view of the unfortunate circumstances in which this second installment, which appeared in our April issue, became so mal-handled in the print shop as to become unintelligible in the closing paragraphs, we consider it due the author and our readers to repeat the article with the missing lines of type replaced.

We regret that it was not possible to make the re-run in our May issue, but therein we could only have printed the corrected paragraphs and not the complete article. The latter being preferable, in order to make available the complete series of articles as the author prepared them, we are now making the re-run. The third article in the series by Mr. Van Kleeck will appear in our July issue.—*Editor.*

Elutriation of Sludge

Elutriation, which might be popularly termed sludge washing, was conceived and developed by A. L. Genter who has lucidly described the process in this magazine[2]. It will not be repeated here. Briefly, the process involves sludge dilution, settling, decanting whereby amino acids in the sludge are washed out with relatively pure water. The process may involve batch fill and draw wash or continuous flow counter-current washing.

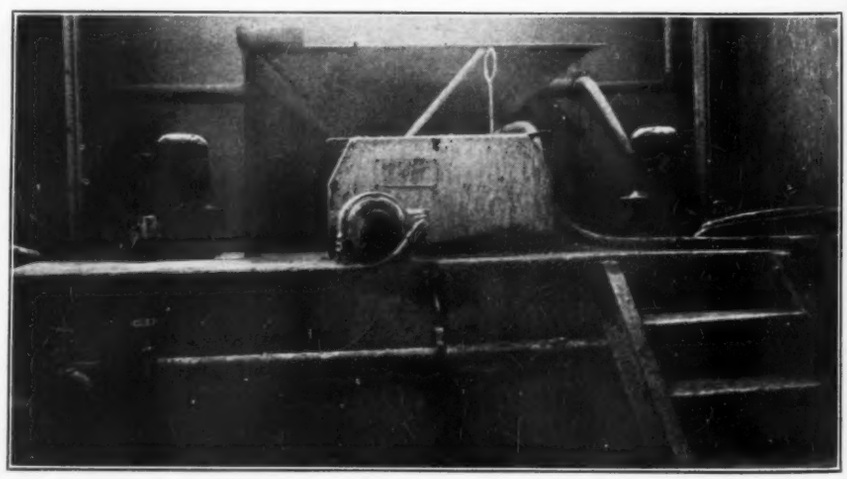
Elutriation eliminates the use of lime and diminishes the amount of ferric chloride required. This simplifies conditioning, prevents the ammonia and amine odor present when lime is used, and saves the cost of an additional chemical, its storage and handling.

Genter has listed other advantages for the process[2]. Against these advantages must be balanced the installation cost, operating costs, and the need for correct mechanical control of the process, for unless the sludge is properly and uniformly washed it will be difficult to condition. With a carefully designed set-up, however, there is no reason why the sludge cannot be properly washed.

The sludge floc produced by ferric chloride alone is unstable and elutriated conditioned sludge should therefore be delivered promptly by continuous feed conditioning tanks to the filter vats. Batch mixing, where sludge is likely to be held, will prove unsatisfactory. Particular care should also be taken that the floc is not broken up before reaching the filter vats. In a summary of operating data to be listed in the fourth paper of this series, the results of sludge elutriation at Hartford, Conn., will be given.

Chemicals Used

The purpose of chemicals for sludge conditioning is to gather the sludge solids into flocs which will release their bound-water and thereby prevent the blinding (clogging) of the filter cloth. The most common chemical used for conditioning is ferric chloride with or without lime. Alum and ferric sulphate, in particular, have been tried as substitutes



Lime Mixing Tank at New Britain, Conn.

This tank is located in the basement. After mixing of the lime and water to produce a lime slurry, the mixture is pumped to a feeding tank equipped with a displacement type mechanical feeder which introduces the lime by gravity to the sludge conditioning tank.

* The first article in this series by Mr. Van Kleeck appeared in our March issue. It dealt with "Filter Design and Maintenance."

[1] Vacuum Filtration of Sludge from Secondary Settling Tanks, Keefer & Kratz, Sewage Works Journal, November, 1935.

[2] A. L. Genter, "Sludge Filtration." Water Works & Sewerage, July 1938.

for ferric chloride but the results have been less satisfactory generally. The market price and conditioning advantages of ferric chloride places this chemical in its present favorable position. As new filter installations go into operation, however, it is sound practice to try different coagulants with the sludge and determine its filtrability by a Buchner funnel set-up. (The use of Buchner funnels will be described later in this series.)

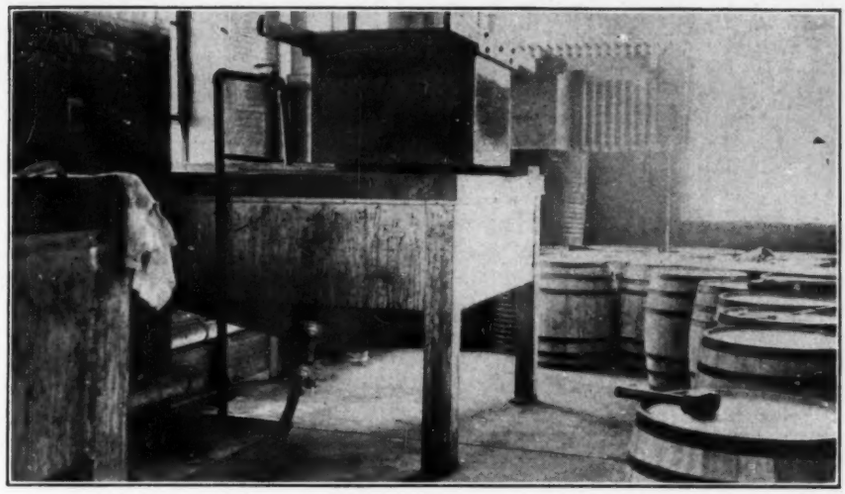
Forms of Ferric Chloride

Ferric chloride is being used for sludge conditioning at all the vacuum filter plants in operation in Connecticut and is proposed for those under construction. Some of these plants use the anhydrous (98%) ferric chloride, purchased in 150-lb. or 400-lb. non-returnable drums. Lump ferric chloride (60 to 62% ferric chloride) is used by other plants. The lump form is somewhat more troublesome to dissolve and more bulk must be handled for an equivalent amount of available ferric chloride. It has previously been shipped in barrels holding about 500 lbs., but at least one manufacturer now ships in sturdy 200-lb. and 300-lb. barrels. These barrels are said to reduce leakage to a minimum and to have some re-sale value. The more recent lump material is also in smaller particles which should hasten dissolving. Liquid ferric chloride has not been used in Connecticut primarily because plant railroad sidings are not available, and the cost of hauling and storing the liquid would exceed by too great a margin the present handling charges for the dry forms.

Feeding Ferric Chloride

Ferric chloride is invariably prepared as a solution before mixing with the sludge. It is a good precaution to wear rubber gloves, if direct contact with the solution is necessary, as the chemical roughens the hands. Irritation to the eyes and throat, sometimes experienced when mixing the anhydrous form, can be avoided by use of a chlorine canister mask.

Weak solutions, of say 10 or 15 per cent ferric chloride, are preferable to stronger solutions, of say 20 or 30 per cent, as more intimate and effective mixing is secured by the additional volume. Since weak solutions require more storage volume for the same percentage of available iron, a high percentage solution can be prepared and diluted with water in the feed line just prior to addition to the sludge. In the fifth and final paper of this series the writer will discuss proper materials for feeding ferric chloride.



Ferric Chloride Mixing Tank (Two Units Are Provided) at West Haven.
The lump or anhydrous salt is dissolved in the wooden box shown on top of the tank. The box is then removed and the tank filled with water to a level to give the desired strength of solution. The ferric chloride is fed by gravity through rubber hose to batch-mix sludge conditioning tank located on the floor below.

There are several satisfactory types of ferric chloride mixing tanks in use. One common style consists of a square rubber-lined basin with a false-bottom wooden box suspended at the center for dissolving the chemical. From a near-by water connection the basin is filled with water and dissolving is accomplished usually by hand with paddles. Another type is a round tank lined with sodium silicate and containing air plates for dissolving and mixing. At plants where only a limited amount of preparation is required, the chemical can be dissolved in discarded wooden or metal barrels. Such barrels will give but a few weeks service as rubber-lining or other special treatment is required to withstand strong ferric chloride solutions.

The solution is commonly fed to the sludge by mechanical feeders located between the chemical storage tanks and conditioning tanks. Adjustable displacement type feeders are recommended for this job rather than orifice feeders. The latter corrode and clog. Sometimes the amount of solution from these feeders is proportioned to the flow of sludge reaching the filter vats by weir settings, floats, or other means. Too much intermechanical control is undesirable, however, and independent settings for each conditioning chemical and sludge flow is preferable.

At batch-mix plants, ferric chloride is sometimes applied by dipping with a pail into barrels or vats of the prepared solution and distributing it through sludge in agitation. Sometimes the solution is introduced into batch-mix conditioning tanks by direct draw-down from the storage vat using a ruler or gage for measurement of the proper amount.

Forms of Lime

Either hydrated or prestolite lime is generally used. Limes high in calcium oxide (CaO) and low in magnesium (Mg) should be purchased. If magnesium is present, magnesium hydroxide, which rapidly ruins filter cloths, will be precipitated. There are two types of readily available hydrated lime. Either is suitable for pH control in sludge digestion tanks but only the high calcium hydrate lime (No. 2) should be purchased for sludge conditioning. Typical analyses of such limes follow:

	No. 1 High-Magnesium or Dolomitic Hydrate	No. 2 High-Calcium Hydrate
Ignition loss	20.00%	24.90%
Silica	1.36%	0.30%
Iron-alumina	0.64%	0.20%
Calcium oxide	46.00%	73.70%
Magnesium oxide	32.20%	0.70%

Spent "Prestolite," also known as "prest-o-lime," runs about 37 per cent available CaO, but as this percentage is rather variable, proper conditioning is sometimes an uncertainty. In addition more bulk must be handled and the material is rather messy to prepare. In its present status spent (hydrated) prestolite is none too favorable a conditioning chemical.

One vacuum filter plant under construction in Connecticut will be equipped with a lime slaker so that pulverized or pebble lime may be used, as materials less costly than hydrated lime.

When lime is added in the conditioning of sludge there is a pronounced ammonia and amine odor in the vicinity of the conditioning tanks and filters. This odor is largely the result of the ammonium hydroxide formed in the following reaction:

$$\underset{\text{(Bicarbonate of Ammonia)}}{NH_4HCO_3} + \underset{\text{(Hydrate of Lime)}}{Ca(OH)_2} = \underset{\text{(Calcium Carbonate)}}{CaCO_3} + \underset{\text{(Ammonium Hydroxide)}}{NH_4OH} + \underset{\text{Water}}{H_2O}$$

Ammonium bicarbonate is naturally present in sludge. The calcium carbonate produced is a contributing factor in the blinding of filter cloths.

Feeding Lime

While dry lime can be added to the sludge for conditioning, better distribution results from preparing milk of lime. Electric paddle mixers are useful for this purpose. The reaction between sludge and lime appears to be slower than with ferric chloride, and milk of lime hastens the reactions which must occur for proper conditioning.

Mixing Period

The best mixing period following the addition of chemicals to sludges varies slightly at every plant. Practice indicates however that short mixes are better than long, and that the tendency is to mix *too long*. A mixing period just sufficient to form a good floc should be used. If mixing is continued beyond this point the floc will partially disintegrate or become stringy.

In continuous-mix conditioning tanks, it should be possible to introduce the chemicals at different points in the tanks. In that way various detention periods may be secured. Generally 5 to 8 minutes should be an ample mixing time for the ferric chloride; in some set-ups 2 or 3 minutes is sufficient. The lime mix should not usually take over 5 to 10 minutes.

The sequence in which the chemicals are added should be considered when both lime and ferric chloride are used. In some cases the lime must be added last or the sludge is virtually unfilterable. In other cases little difference can be noted and the ferric chloride and lime may be added practically together. Sometimes the conditioning set-up dictates the order of addition. For example, a Connecticut plant filtering digested sludge found that unless the lime was added first the vigorous mechanical agitation provided for the conditioning tanks broke up the floc produced by the ferric chloride and resulted in a poor filtering sludge. Laboratory work at this plant shows, however, an advantage in adding the lime last—but, only under ideal stirring conditions.

Amount of Chemicals

Field experience has shown that there is (with most sludges) an optimum amount of ferric chloride to be used with or without lime. On either side of such optimum conditioning is adversely affected. Thus, an over-dose of chemicals may produce a poorly filtering sludge, as well as cause more damage to filter cloth than under-doses. Over-doses of lime used in conjunction with ferric chloride can usually be checked by employing pH tests on the filtrate. This will be discussed in the fourth paper of this series.

With many sludges the chemical requirements, if plotted, will show a sharp peak giving very definite dosages for optimum filtration (as shown by Buchner funnel tests); some other sludges have a flatter curve and the doses are not so critical. It is important for an operator to determine the type of curve for his sludge. Sludge is a complex conglomerate of widely varying characteristics and filtering results can be greatly improved if these properties are studied and known.

Computation of Amount of Chemicals Required

The chemicals used for sludge conditioning may be compared at various filter plants, if the chemical doses are reported by per cent *on a dry basis*. So many pounds of chemical per 1000 gallons of wet sludge means very little if this sludge has 10 per cent solids one day and 15 per cent the next. As a guide to operators, and others not familiar with this method of computation, the following examples are given for determining the strength of ferric chloride solutions and the dry basis reporting of ferric chloride and lime quantities:

The ferric chloride should be reported as the pounds of anhydrous ferric chloride used per 100 pounds of dry solids filtered, i. e., per cent based on solids content, not volume. *The dry solids should include the sewage dry solids plus the dry ferric chloride added.*

Let us assume for an example that a plant is buying lump ferric chloride. This chemical contains approximately 60 per cent available dry ferric chloride. The remaining 40 per cent is water of crystallization. Suppose 20 pounds of the commercial material, as weighed, is used to filter 500 gallons of digested sludge containing 10 per cent sludge solids. The specific gravity of the sludge is found to be 1.03. (This can be determined by weighing a unit volume and comparing its weight with the weight of an equal volume of water. Thus, $\frac{\text{Wt. of sludge*}}{\text{Wt. of water*}}$ =specific gravity.)

Then, 500 x 8.33 (wt. of gal. of water in lbs.) x 1.03 = 4289.95, say 4290 lbs. (total wt. of wet sludge).

Since, 10% of this weight is dry solids, 4290 x 0.10=429 lbs. *dry sewage solids.*

Now, 20 lbs. of commercial chemical x 0.60 = 12 lbs. of dry ferric chloride ($FeCl_3$).

Then, 429 + 12 = 441 lbs. (*total dry solids*).

Since,

$$\frac{\text{Lbs. dry } FeCl_3}{\text{Lbs. dry sewage solids + lbs. dry } FeCl_3 \times 100} = \% \text{ } FeCl_3 \text{ dry basis.}$$

Then, $\frac{12}{441} \times 100 = 2.7\%$ $FeCl_3$ used on a dry basis.

In passing, it should be pointed out that not all of the total dry solids computed above are in the sludge cake, some being in the filtrate. The quantity of solids in the filtrate is a small percentage of the total, but can be computed if a total solids determination is made on the filtrate, and if the total lbs. of filtrate discharged by the filter during the run are known. By eliminating the spe-

*Do not include the weight of the container in these weights.

cific gravity calculation for the wet sludge the solids loss in the filtrate will generally be about balanced, and the result will be more nearly the dry solids removed in the filter cake. Several calculations seem to confirm this if the filter cloths are in good condition.

If the wet sludge cake weight is known and ferric chloride only, or some other *one* chemical is used as a conditioner, the per cent moisture of the cake and the total dry solids in the cake, which include the weight of the chemical, can thus be determined. The pounds of dry ferric chloride used divided by the pounds of solids in the cake, and multiplied by 100, gives the per cent of ferric chloride on a dry basis.

Computation of Strength of Ferric Chloride Solutions

(A) Frequently the lbs. of dry ferric chloride used must be determined from a previously prepared solution. The strength by weight of fresh ferric chloride solutions is computed as follows:

Suppose, 500 lbs. of 60% commercial ferric chloride has been added to 500 gallons of water, then,

500 (gals. of water) x 8.33 = 4165 lbs. of water.

500 (lbs. of commercial lump ferric chloride) x 0.60 = 300 lbs. dry ferric chloride.

4165+500=4665 total lbs. water and commercial chemical.

$$\frac{300}{4665} = 0.064 \text{ or } 0.064 \times 100 = 6.4\%$$

solution of ferric chloride.

Knowing the strength and the number of gallons of solution used, the lbs. of dry ferric chloride is readily computed. Thus, for example, suppose 20 gallons of a 20% solution of ferric chloride (strength of which has been determined as above) is used for filtering a certain quantity of sludge. Then,

20 (gals. of solution) x 8.33 (wt. of gal. of water in lbs.) x 1.154 (specific gravity of a 20% solution at 17.5°C.)*x0.20 (per cent strength of solution) = 38.5 lbs. of dry ferric chloride used.

The specific gravity figure of course varies with the strength of solution. It can be obtained from handbooks, determined by weight as explained in the previous section, or by the use of a hydrometer. Determination by unit weight is recommended.

[* This figure was taken from the "Handbook of Chemistry and Physics," The Chemical Rubber Co., Cleveland, Ohio, Pp. 1100.]

(B) It is assumed that the commercial chemical contains a definite amount of available ferric chloride. This is not always true. Furthermore ferric chloride solutions tend to stratify and when drawing the solution from the bottom of the storage tank there is a tendency for the strongest solution to be drawn off first and a weaker solution drawn as the vat is emptied. This is caused not only by natural stratification but from a tendency for absorption of moisture from the air as the solution stands and the diluted mixture is drawn off last.

The titration method given below is useful for checking ferric chloride solutions. Samples for testing must be collected with great care. They may be taken directly from the solution feed line, or by compositing a sample from portions taken at various depths in the storage tanks.

The titration method gives greater accuracy and is easily performed. The procedure follows:

Take 2 cc. of the prepared $FeCl_3$ solution from the storage tank. Dilute with about 50 cc. of water and add 2 cc. of pure hydrochloric acid (HCl). Add 10 cc. of 30% potassium iodide (KI) solution and mix thoroughly. The mixture can be left in the dark for about 10 minutes, although omission of this refinement is generally permissible.

Titrate with N/10 sodium thiosulphate ($Na_2S_2O_3$) solution, using starch solution as an end point indicator. About one (1) cc. of starch solution is added when the mixture is pale yellow. If fading of the starch color is not permanent after titration, a second sample should be held in the dark as suggested above.

The milliliters (cc) N/10 sodium thiosulphate x 0.0081 = grams $FeCl_3$ per cc. of ferric chloride solution. The percent ferric chloride in the solution will then equal the grams of $FeCl_3$, per cc. of solution, times 100 and divided by the specific gravity of the $FeCl_3$ solution.

For example, suppose 13 cc. of N/10 sodium thiosulphate solution are used in the titration above and the specific gravity of the solution of $FeCl_3$ has been found to be 1.07 by the unit volume weight method previously described. Then,

$$\frac{13 \times 0.0081 \times 100}{1.07} = 9.8\% \text{ ferric}$$

chloride solution.

This titration method is very easy to perform. Operators possessing limited laboratory facilities or who are not familiar with the preparation of solutions of known strength can use about 3 grams of the KI crystals in place of the solution. The one-tenth normal (N/10) sodium thiosulphate may be purchased ready for use from laboratory supply houses. If kept in the dark the solution will be suitable for use for from 3 to 6 months, beyond which time it is likely to lose strength.

Computation of Lime Used

The lime used in sludge filtration is reported as pounds of available CaO used per 100 pounds of dry solids, i. e., per cent CaO of dry solids. *The weight of dry solids includes the weight of the dry sewage solids and the weight of commercial lime,* (the lime is assumed to be free of moisture).

Suppose 10 50-lb. bags of lime containing 72% available CaO (look on the bag for the CaO content) are used for conditioning 3000 gallons of 10% solids sludge.

Then, 3000 x 8.33 x 0.10=2499, say 2500 lbs. of dry sewage solids. (Specific gravity of sludge has been omitted. See discussion under "Computation of Ferric Chloride Used from Wet Sludge Filtered.)

10 bags at 50 lbs. per bag = 500 lbs.

2500 + 500 = 3000 lbs. *total dry solids.*

500 x 0.72 = 360 lbs. of available CaO.

$$\frac{360 \times 100}{3000} = 12\% \text{ CaO. (dry basis).}$$

Ans.

(The next paper by Mr. Van Kleeck will discuss some of the other factors affecting sludge conditioning, together with the computations of filter yields and the disposal of filter cake.—*Ed.*)

SENATE PASSES BARKLEY POLLUTION BILL

At this writing the Senate has passed the so-called Barkley Pollution Bill. After considerable debate all amendments offered by those proposing harsher measures were rejected.

The Barkley Bill calls for administration of the law by the U. S. Public Health Service and provides for Federal loans and grants for the purpose of constructing treatment plants by industry, as well as municipalities and other political sub-divisions. The Bill is now in the House.

SCREENINGS DESTRUCTION AT MILWAUKEE

Grit Also Burned in Multi-Zone Rabbling Furnace

By GEORGE R. LEWERS,
Chief Design Engr.,
Underpinning & Foundation Co.
NEW YORK, N. Y.

THE Sewage Disposal Plant of the City of Milwaukee has always been famous for its conservation of sewage sludge and its marketing as fertilizer. The only waste product of the plant consists of coarse screenings and grease covered grit. These are incinerated. The screenings are passed through batch centrifuges to reduce the moisture content, mixed with grit and then burned to a mineral ash. The former incinerators used for this purpose were not economical in the use of fuel. To reduce the cost of this operation, a contract was entered into for the installation of a Multi-Zone multiple hearth furnace of a capacity of 40 tons per 24 hours.

The Furnace

The furnace is of the multiple zone rabbling type. The screenings, after dewatering in the batch centrifuges to about 70% moisture content, are mixed with the grit and fed into the top hearth of the furnace. Drying of this material takes place on hearths 1 and 2, burning on hearths 3, 4, and 5, and the ash drops onto hearth 6; from here it is discharged into a bin and then ejected by steam at required intervals to a large storage tank and finally trucked to the dump.

The heat generated in the burning zones is led into the upper drying hearths. The ducts and dampers are so arranged that the gases from the upper hearths can be led either directly to the stack or to the heat exchanger. The heat exchanger is connected by flues to hearth No. 4 and the mixing of the gases from the upper hearths with these hot gases from No. 4 is usually sufficient to remove all obnoxious odors. However, if odors still persist the gases from the drying zone (hearths 1 and 2) can be introduced into hearth 6 and re-circulated through the burning zone. The temperature of the gases in the burning zone is maintained at approximately 1200° F. Control dampers are so arranged that the temperatures therein are under control within a range of 100° F. The burning begins on hearth No. 3 and is completed on hearth No. 5.

The operation of the furnace is continuous; the only shutdowns for overhauling and checking equipment occur three or four times a year.

Power Consumed

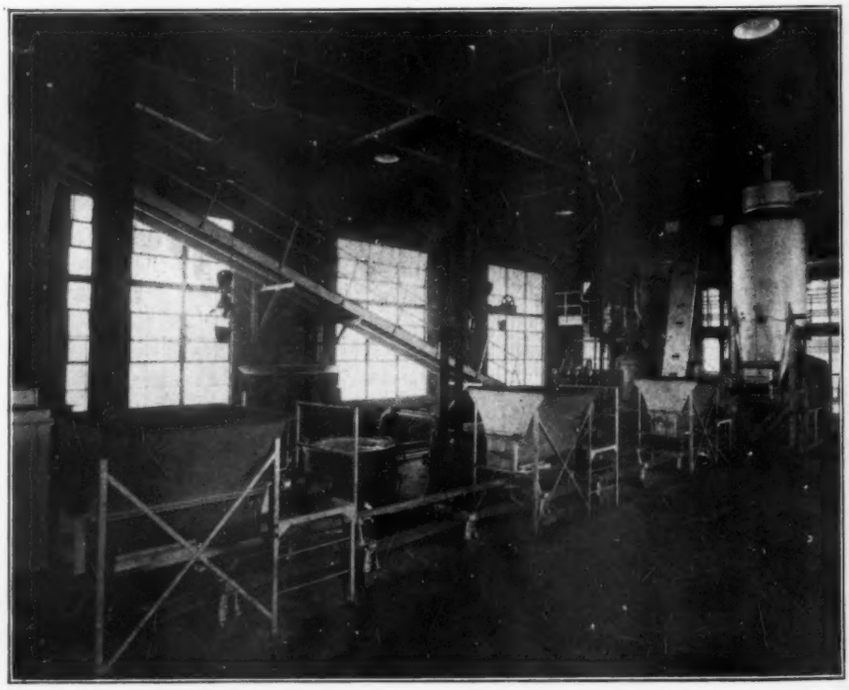
The heat content of the screenings varies between 7,000 and 9,000 B.T.U.'s per pound. No additional fuel is required to burn this material. The power consumption varies with the load, and ranges between 5 and 6 K.W. per 24-hour shift.

The furnace rests on 6 H. columns, about 6 feet in length, to give ample room for the mechanism that drives the center shaft. It is cylindrical having an outside diameter of 14 feet 3¾ inches and is 17 feet in height, above the columns. The outer steel shell is ⅜-inch thick. It is made in sections reinforced with butt straps and riveted together.

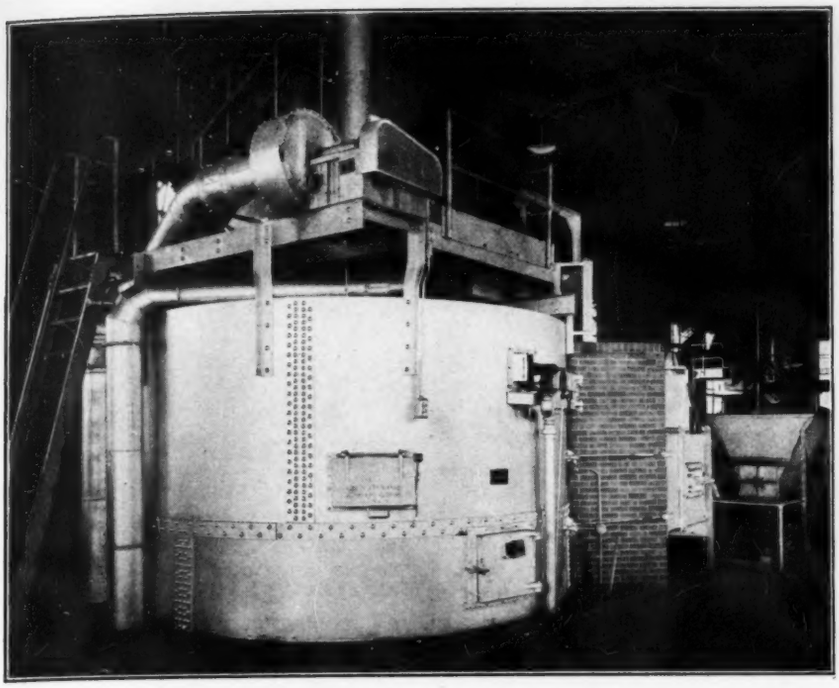
The steel casing is lined with 9 inches of firebrick and is insulated with 4½ inches of rock wool, forming the sidewalls. Horizontally, the furnace is divided by 6 self-supporting firebrick hearths.

Rabbling Units

The center shaft is of high grade Cast Iron, with an outside diameter of 18 inches. It is made up of 5 sections bolted together and is supported at the bottom by a self-aligning roller step bearing, running in oil. Directly above this bearing a bevel gear is driven by a steel pinion, fas-



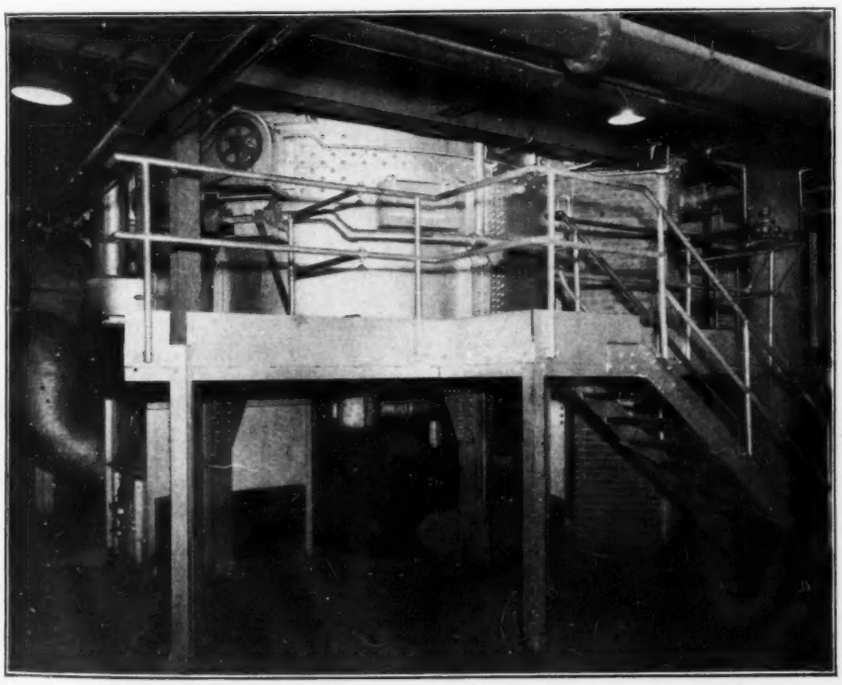
Milwaukee's Centrifuges, Shredders and Conveyor which Delivers to Top of Incinerator



Drying Zone of Incinerator Milwaukee Sewage Disposal Plant, Milwaukee, Wisconsin

tened to a gear reducer, which in turn is driven by a variable speed reducer and motor so that the speed of rotation of the shaft and the travel of the rabble arms is controlled at all times.

Sockets are cast in the center shaft to hold the rabble arms. The method of fastening these arms to the center shaft is such that the arms can easily be replaced. An extra heavy steel inner shaft is mounted within the Cast Iron center shaft for conducting the cooling air. Four rabble arms are provided in each of the top three hearths, and two arms in each of the lower three hearths. The rabble arms in the drying zone (the top two hearths), are of high grade Cast Iron, while in the incinerating or lower four hearths they are of high chrome nickel alloy. The rabble teeth are of like material and are so spaced that the travel of the material throughout the different hearths is uniform.



Burning Zone and Driving Mechanism of Incinerator Milwaukee Sewage Disposal Plant, Milwaukee, Wisconsin

At the top and bottom of the furnace there are lute seals filled with sand which have a lute cap fastened to the center shaft rotating within them. This prevents infiltration of the outside air as well as the escape of gases from within the furnace. The intermediate out-hearths are equipped with lute caps and rings to prevent short circuiting of gases from one hearth to another. Two Cast Iron doors are provided at each hearth level for access to the interior and for inspection.

Combustion Self-Sustained

There are six oil burners, one on hearth No. 1, two on hearth No. 4, and one on hearth No. 6. Two oil burners are installed on the heat exchanger.

Fuel oil is used to heat up the furnace before screenings are introduced, and until such time as combustion on hearths 3, 4, and 5 is established. The use of fuel is then discontinued because sufficient heat is generated from the screenings for complete and odorless incineration.

A recording pyrometer gives a continuous record of temperatures at essential or critical points.

The electrical equipment consists of a switchboard with starting equipment for all motors such as the center shaft drive, fan motors, oil pumps and blower furnishing primary air for the oil burners.

The fan equipment consists of a cooling air fan of 2000 c.f.m. capacity, and an induced draft fan of 2100 c.f.m. capacity to handle the cold gases, and another of 7300 c.f.m. capacity to handle the hot gases.

The oil burners are Anthony, type A, size 3 in., with a capacity ranging from 1½ to 4 gallons per hour.

The contract for the incinerator was let by the Sewerage Commission of the City of Milwaukee. Mr. James L. Ferrebee, Chief Engineer, and Mr. W. W. Genrich, Plant Division Engineer, were in charge of construction. The Underpinning & Foundation Co., Inc., of New York manufactured and installed the equipment.

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CAPE MAY'S NEW DIESEL SEWAGE WORKS

By E. SCHOONMAKER
Engineer
Fairbanks-Morse Co.
NEW YORK, N. Y.

THE "March of Time" caused more than a mechanical crisis in Cape May, New Jersey, when last summer the old Madison Avenue sewage pumping station became wholly inadequate through obsolesence. The old gas engines, needing constant attention, could not be operated for more than two periods a day. The pumps, as a result, could not handle the flows resulting from normal growth and the natural increase in population. As the sewer lines in reality became an overflowing collection system, it created a serious health menace.

What to do in the public interest was suggested by Perring & Remington, Consulting Engineers, of Camden, New Jeresey, and Baltimore, Maryland, who had been engaged to conduct a study and submit recommendations. These consultants recommended a new works so regulated as to have a capacity varying from 0.5 m.g.d. to 5.5 m.g.d., which the city administration approved. To achieve this and guarantee simplicity and dependability, every practical method of performance was considered before final unanimous decision was made to employ Diesel engines, direct connected to non-clogging horizontal sewage pumps.

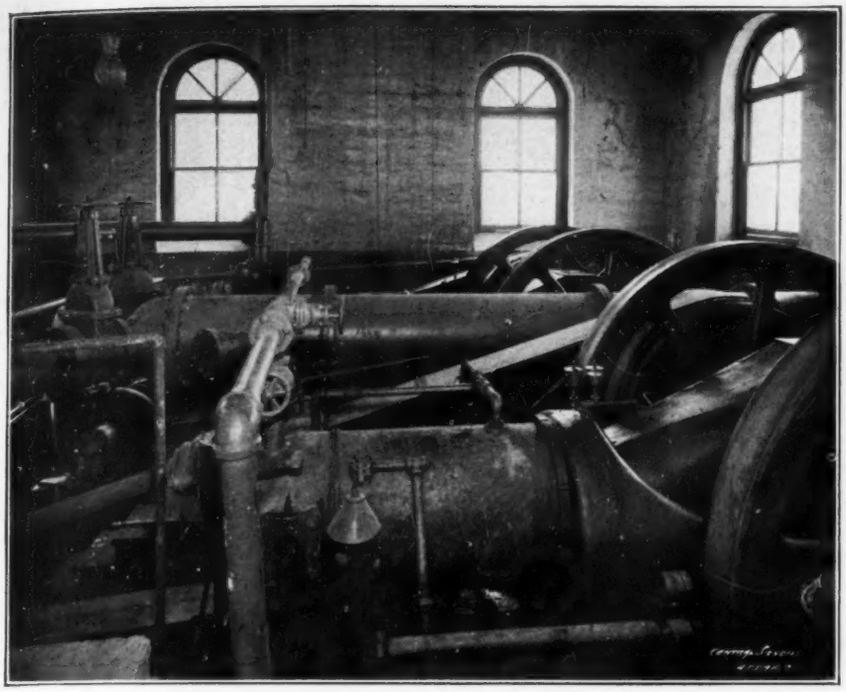
The Installation

The installation consisted of a 4-cylinder (4¼") Diesel engine, direct connected to a 6", 1200 g.p.m. pump; and a 6-cylinder (5½") Diesel engine, direct connected to an 8", 2800 g.p.m. pump. The installation was completed late in 1938.

Thus began a new cycle of performance in which these Diesel engines and pumps provided a maximum range of speed regulation without the use of speed reducers. By

Cape May's New Sewage Pumping Station

Note the effective use of glass-brick to light the collecting well, grit and screen chamber also the forced draft-vent stack. In the rear is the obsolete plant. Note, also, the plant proximity to residences.



Old Pumping Equipment
Obsolete and costly to operate gasoline engines.

eliminating all mechanical conversion losses in this manner and coupling this operating advantage with sewage influent regulation, the entire demand is handled with the minimum amount of equipment. In this way, the engineers gained many worthwhile investment and construction economies without impairing utility. These values, of course, were not obtained without some degree of ingenuity and naturally the City Council is delighted with the resulting low rate of $1.50 for pumping one million gallons of sewage out into Delaware Bay, approximately 19,000 feet distant.

Some idea of the anticipated pumping costs, based on other conditions than prevail at present, can be figured from the following:

	Gallons
Average Summer Flow	1,500,000
Average Winter Flow	1,000,000
Normal Rainy Weather Flow	3,000,000
Heavy Rainy Weather Flow	4,000,000

Foundation Design

The foundations for this equipment were not built until the engineers had conducted a series of test borings. This was considered necessary on account of the proximity of so much sand and water. As a result, Perring & Remington specified special "piling" foundations, which were put in and insulated from the building by cork and bitumastic foundation mats and side walls. By installing the engines and pumps in this manner, the possibility of future mis-alignment was averted, and vibration observed is at near perfection mark.

Coupled with the fact that adequate Maxim Silencers were used on each engine, a very quiet installation was established.

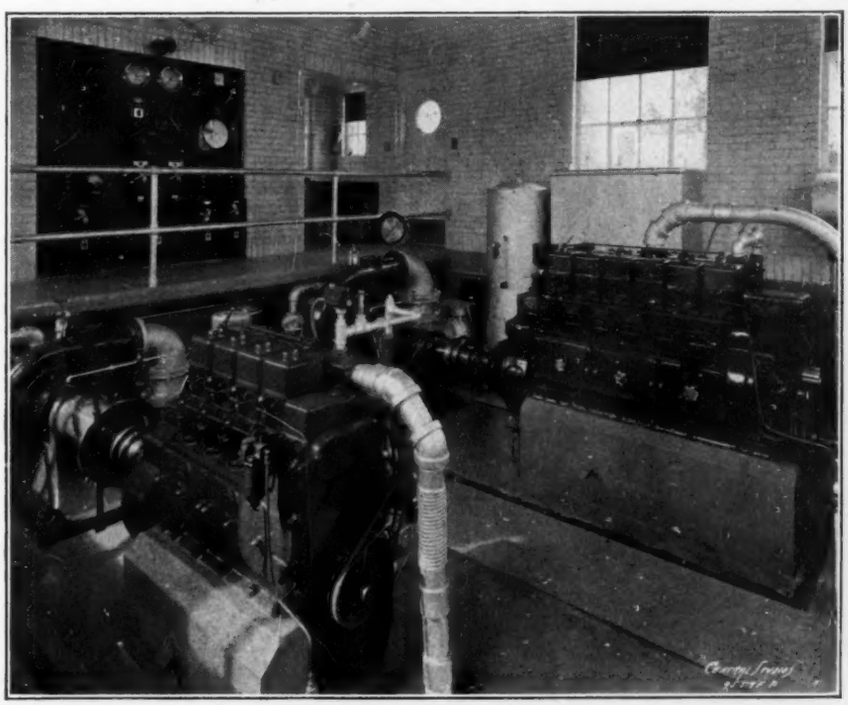
Operating Safeguards

The use of other simple operating safeguards also contribute to exceptional engine performance.

Such devices as an automatic engine howler, warning against insufficient cooling water and lubricating oil was also installed. The bearings of each sewage pump are protected by a positive supply of cooling water automatically furnished by a Fairbanks Morse pressure system. An alarm also indicates the high and low water levels in the sewage receiving wells, so that operating adjustments can be made at the critical points as the occasion demands. The quality of performance is further enhanced by the use of oil filters, air cleaners, thermometers and thermostatic circulating water controls, all of which are located on each of the engines. The pumps operating with 20 foot suction lift are also safeguarded against lost suction, by the automatic manipulation of check valves in the suction lines. This obviates the necessity of using vacuum pumps for priming.

The Grit and Screen Chamber

The advantage of operating according to demand reduced construction costs, because it became unnecessary to enlarge or add to the present receiving well. This fitted in with the plans of the engineers to make the screening and grit chamber an integral part of the suction well.



New Pumping Equipment
Note sanitary appearance of station; modern Diesel Engines and horizontal pumps; automatic control and alarm system. Equipment is listed at end of this article.

The latter, reached by a spiral stairway, is equipped with a chain hoist for removing screenings; adequate air ducts, connected to the ventilation stack in the rear of the plant; the grit chamber, with hopper bottom grit channel; inverted rake cleaning mechanism; gas tight roofs over the wells; moisture proof float switches operating motorized 30x36" sluice gate; and, water level indicators and alarms.

Combination stop plates and adjustable weirs are also installed in the 18" discharge channel to the suction wells. This permits the diversion of sewage into either pump suction compartment, and the control of the sewage level within the screening chamber.

Engine and Pump Room

The engines, pumps, switchboard and accessory equipment are installed in a super structure immediately adjacent to the well housing, all of which was constructed by Thomas Proctor & Sons, Contractors, of Long Branch, N. J. They erected a very attractive cover for the entire plant, utilizing glass blocks over the well end and faced brick for the balance. The atmosphere of the whole plant is one of wholesomeness, gained from the clean impression created by the use of light buff brick work in the engine room, grey painted floors and a white painted well shaft. Without question, Cape May's new station is New Jersey's outstanding installation of the year.

The project was completed under the jurisdiction of George P. Wentzell, Commissioner of Works for Cape May.

Equipment

For the benefit of those who may be interested the following is a partial listing of equipment used in Cape May's new plant:

Diesel Engines: 4-cylinder, Model 36, 4¼" engine with effective speed control from 750 to 1200 r.p.m.—by Fairbanks-Morse Co.; 6-cylinder, Model 36, 5½" engine with effective speed control from 400 to 750 r.p.m. —by Fairbanks-Morse Co.

Sewage Pumps: 6" horizontal sewage pump with maximum capacity of 1200 g.p.m.—by Fairbanks-Morse Co.; 8" horizontal sewage pump with maximum capacity of 2800 g.p.m.—by Fairbanks-Morse Co.

Water Pumps for Bearings: 2 h.p. 3-60-220/440 volt, 3450 r.p.m. builtogether pump with pressure tank and automatic control — by Fairbanks-Morse Co.

Silencers: 2 Maxim Silencers—by Maxim Silencer Co., Hartford, Conn.

Well House Equippage: Discharge Venturi by "Simplex"; Combination Bar Screen and Grit Mechanism—by Link Belt Co.; Water Level Indicators and Alarm Chain Hoist.

Engine Accessories: 2 Exide Starting Batteries—24 and 32 volt; 5 De-Luxe Lubricating Oil Filters; 3 Puralator Fuel Oil Filters; 2 Reliance Tachometers; 2 Burgess Air Cleaners; 2 Cooling Water Thermostat Switches — by Detroit Lubricator Co.; 2 Folk "Steelflex" Couplings; 2 Rectigon Battery Charging Units.

Switchboard Equippage: Westinghouse Circuit Breakers, Fairbanks-Morse Lube-Oil Meters, Brown Pyrometer, Oil and Circulating Water Alarm, Edwards' Electric Warning Horn, General Electric Relay Switch, Westinghouse Inflow Water Level Meter, Schwarze Electric High-Low Water Alarm, Simplex "Venturi" Meter, Indicator and Recorder.

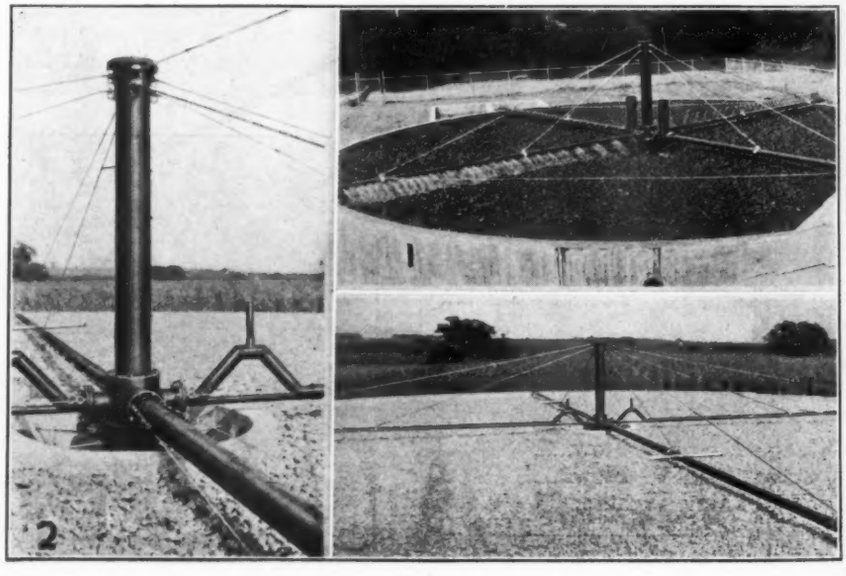
NOVEL "DOUBLE FLOW" ROTARY DISTRIBUTORS

Proven at Two Plants

From the Pacific Flush Tank Co. have come the accompanying photographs of two installations of their recently perfected "Double Flow" Rotary Distributors at Belle Plain, Iowa and Metuchen, N. J. Excellent performance of both units has branded the idea successful and the scheme dependable.

The "Double Flow" principle was incorporated in the design to add flexibility far beyond that of the conventional type of rotary distributor. In short, to greatly increase the permissive range of flow without the necessity of providing dosing syphons and additional head for handling flows greater than 250% above the minimum rate. The "Double Flow" scheme has proved capable of handling flows to at least 500% above the minimum, with approximately the same low variation in head as is required with the conventional rotary distributor.

The uniquely successful feature by the "Double Flow" mechanism may be compared with the twin carburetor installations on high powered automobiles. The distributor has four arms but two are automatically held inoperative as reserve arms. These arms take over their share of the load when flows reaching the filter are high enough to impose the pre-determined maximum allowable head on the two continuously functioning arms. The scheme is simple enough; the sewage flow in excess of 250% of designed minimum operating flow passes over a "hump-spillway" at the inlet to the two reserve stand by arms. These shunting spillways adjacent to the center post, (see picture) are vented to preclude syphon action or air binding.



"Double Flow" Filtering

At Metuchen, N. J. (above); Belle Plain, Iowa (below)

IN ATLANTIC CITY— IT'S MATHIESON CHLORINE

Water Department
CITY HALL
ATLANTIC CITY, N. J.

VAN GILDER, ENGINEER AND SUPT.
STANLEY B. JOHNSON, CASHIER

May 1,1939

The Mathieson Alkali Works, Inc.,
60 East 42nd St.,
New York, N. Y.

Gentlemen:

We are glad to reply to your inquiry concerning our use of your products.

We have been users of Mathieson Chlorine for about 20 years in which time we have received excellent service from your organization.

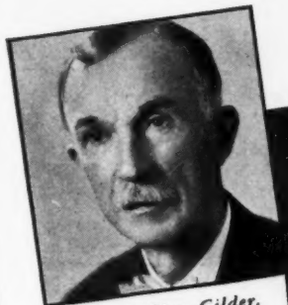
One feature we have particularly appreciated is the freedom from trouble with clogging tubes. At one time we experienced this difficulty when using another source of supply.

For the past five years we have found your multiple unit cars a great convenience as well as an economy. These cars eliminate extra handling of cylinders because of the greater capacity of the containers.

We are also users of HTH which is highly satisfactory for use in sterilizing our pumping basins, and in addition easy to use.

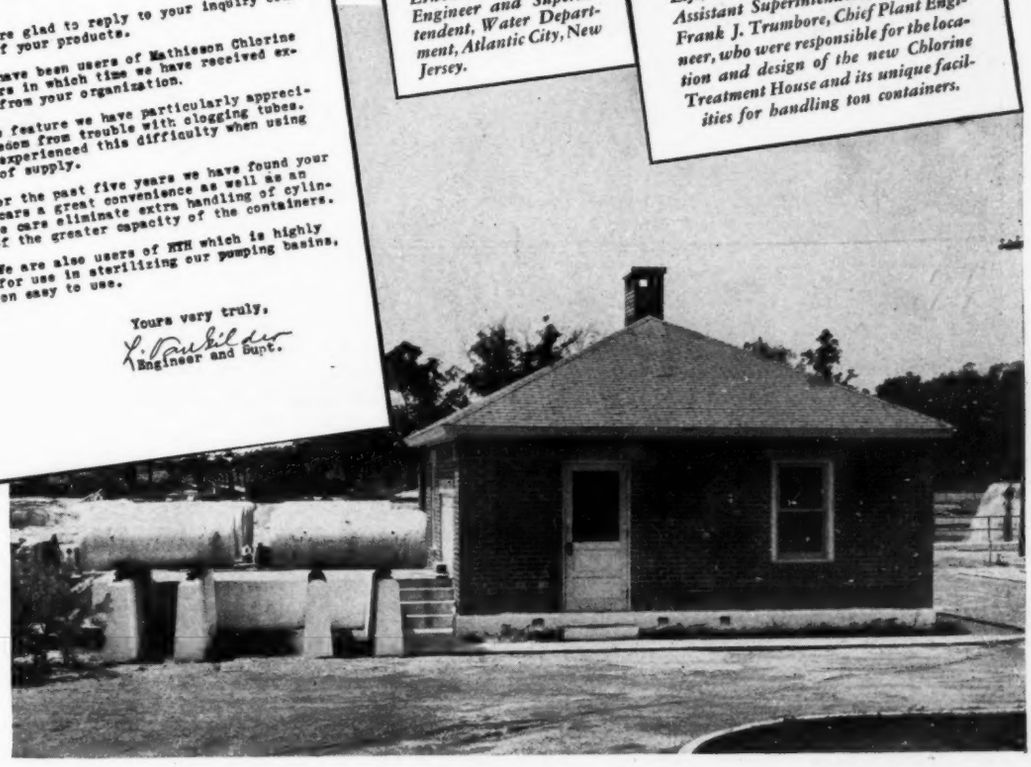
Yours very truly,
L. Van Gilder
Engineer and Supt.

LVG:H



Lincoln Van Gilder, Engineer and Superintendent, Water Department, Atlantic City, New Jersey.

Left, Maurice Brunstein, Chemist and Assistant Superintendent, and right, Frank J. Trumbore, Chief Plant Engineer, who were responsible for the location and design of the new Chlorine Treatment House and its unique facilities for handling ton containers.



The new Chlorine Treatment House, Atlantic City Water Department, showing ton containers of Mathieson Chlorine.

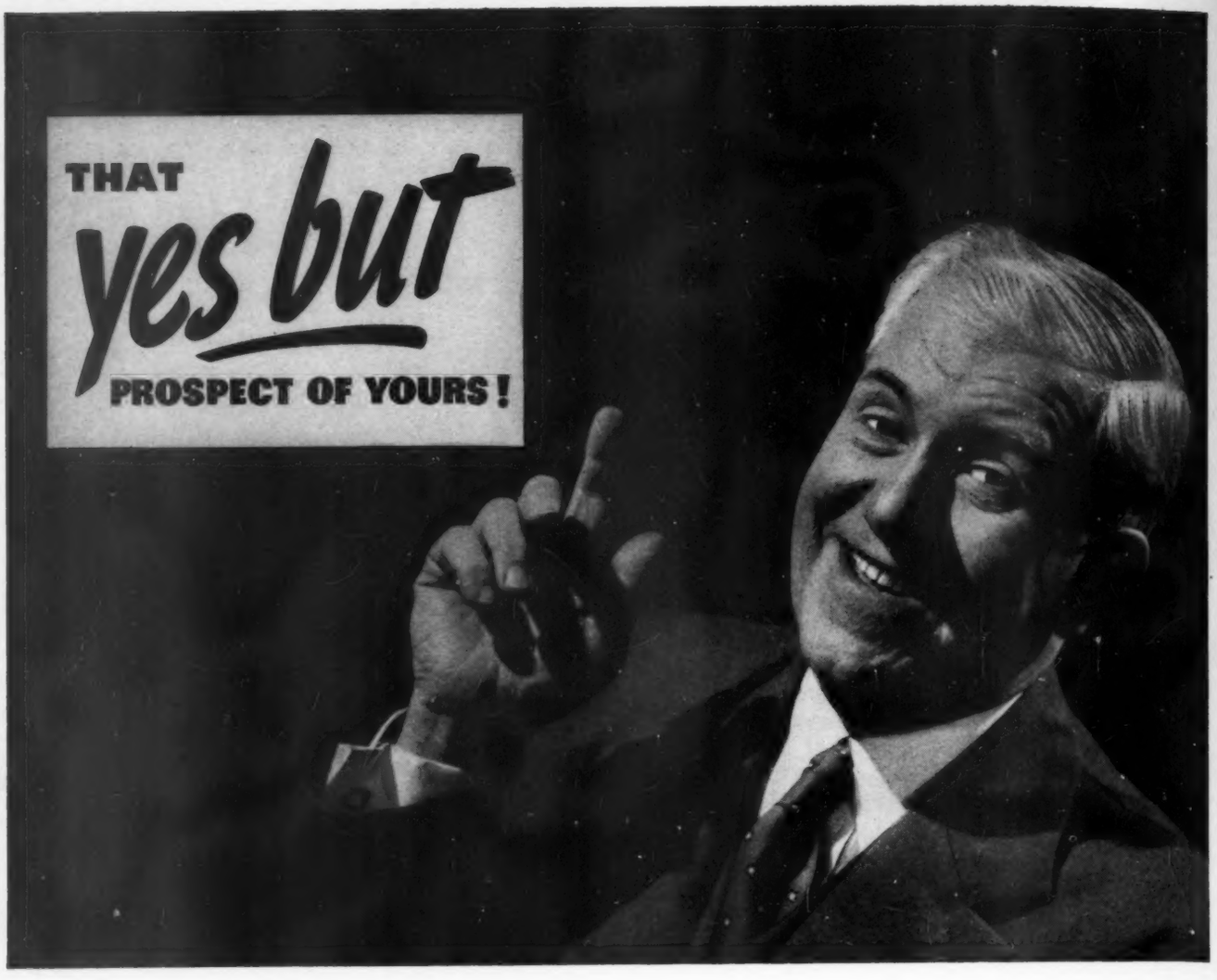
The Atlantic City Water Department, as stated by Mr. Van Gilder in the above letter, have been users of Mathieson Chlorine for over twenty years. Until about five years ago deliveries were taken in 105-lb. cylinders. Then it was decided to take advantage of the economy and convenience of Mathieson Chlorine in multiple-unit tank cars carrying fifteen one-ton containers. Atlantic City also uses Mathieson Ammonia for chloramine treatment and HTH for sterilizing pumping basins, etc.

Atlantic City is only one of many progressive cities throughout the country that find Mathieson Chlorine the ideal answer to the need for a pure chlorinating product—trouble-free containers and valves, prompt delivery service, and courteous, expert cooperation at all times, whether the job be water purification, sewage treatment or swimming pool sanitation.

Write today for a copy of our interesting and informative 80-page manual—"Hypo-Chlorination of Water."

THE MATHIESON ALKALI WORKS (INC.) 60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . AMMONIA, ANHYDROUS and AQUA . . . BLEACHING POWDER . . . SODA ASH . . . CAUSTIC SODA . . . BICARBONATE OF SODA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . LIQUID CARBON DIOXIDE . . . GYPSUM PRODUCTS



SAD is the day when your salesmen bump into this happy soul . . . this genial buyer who agrees with everything that salesmen say, and signs nothing while they are present. "Yes", he assents. "Yes, indeed, I'd like to buy . . . BUT, I can't do anything until Fall . . ." Always smiling, always agreeable, he affects a mask of sales resistance by pretending to have no resistance at all.

Underneath, these "hard-to-sell" prospects are pretty shrewd fellows. They like to check what they hear against facts from other sources before they make up their minds. That's one of the reasons they read WATER WORKS AND SEWERAGE. And the thing that's important to you is that they hang up their defensive masks when they pick up WATER WORKS AND SEWERAGE to glean progressive ideas about their livelihood. They are with editors in whom they have confidence . . . for whose counsel they have paid cash in advance with voluntary subscriptions.

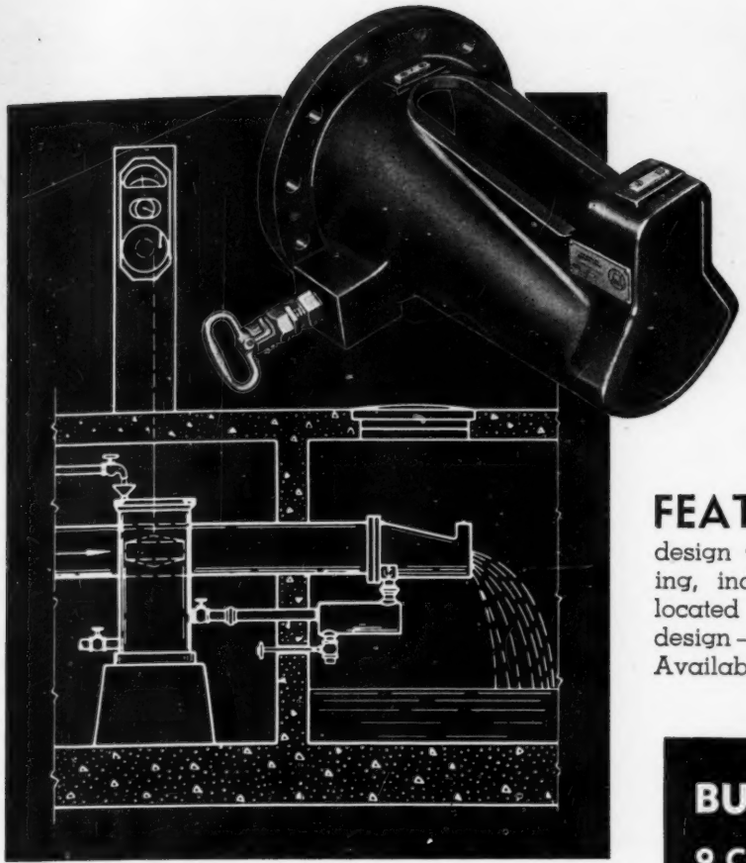
Your advertising in WATER WORKS AND SEWERAGE will back up your salesmen—will reach your "yes, but" prospects when they are in the mood to eliminate the "but".

Highest editorial standards and publishing integrity.

WATER WORKS AND SEWERAGE

bears the two hall-marks of known value

Proved reader interest in terms of paid circulation.



Type M Register-Indicator-Recorder Connected to Kennison Open Flow Nozzle

BUILDERS Kennison Nozzle

Measures: raw sewage and trade wastes in partially filled collecting sewers . . . activated sludge from primary settling tanks . . .

FEATURES . . Accurate over wide range of flow • Simple "self-scouring" design • Easy inspection through open top • Recording, indicating, and totalizing instruments can be located nearby or at any distance • Non-clogging design — continuous through-way to pass debris • Available in sizes from 6" to 36" diameter.

Completely described in NEW Bulletin 308

BUILDERS IRON FOUNDRY
"Builders of the Venturi Since 1891"
9 Codding St. Providence, R. I.

WHAT'S Aa? - - - - What's Z-Iron?

What comes between these two words?

Over 8000 definitions of engineering terms and phrases. You will find all the answers in the second edition of

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GILLETTE PUBLISHING CO.
330 S. Wells St. Chicago, Ill.

NEW SEWAGE SAMPLER

● The new Infilco Sewage Sampler collects and composites samples at any desired interval. It may be either manually regulated or equipped with an automatic proportioner to vary sampling with rate of flow.

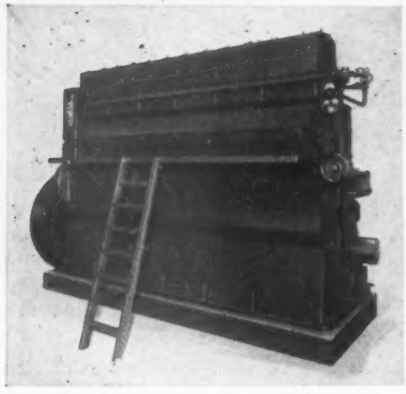
The sampler is not only dependable in performance, but is compact, neat and attractive in appearance.

● Write for further information.

INTERNATIONAL FILTER CO.
325 W. 25th Place, Chicago, Illinois
INFILCO

EQUIPMENT NEWS

Worthington Announces New Diesel

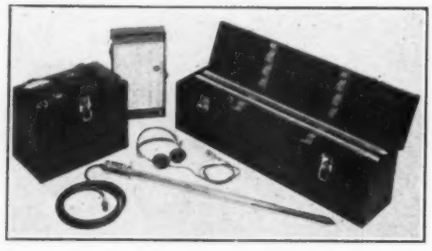


● Worthington has announced a new totally enclosed, direct injection Diesel engine, trunk-piston type, using a direct injection system for fuel oil feed. The new engine is of the simplest and most compact design consistent with high efficiency and accessibility. All moving parts are wholly enclosed (see cut).

A feature of the new Worthington Diesel is the cone-type cylinder head which eliminates all possibility of head cracking, and also the need for a gasket between head and liner. The lubrication system incorporates jointless cast-in oil pipes and positive sight feed for all vital points of lubrication. It is especially designed to stand up under continuous heavy duty loading and to handle peak loads such as require intermittent service.

For bulletin S-500-B-36 write Worthington Pump and Machinery Corp., Harrison, N. J.

New Leak Locator



● A new model leak detector and locator, for spotting leaks on water, gas, steam or air lines, has been announced by Western Instrument Company, of Los Angeles.

Known as the Model 3 VL Locator, the equipment consists of a sectional probe (see cut) capable of reaching any practical depth, that may be dug with an earth auger or other tools; a heavy duty, waterproof case containing batteries and detection instruments, ear-phones and other auxiliary items. The electrical unit, ready for use, weighs thirty pounds.

The apparatus makes use of the vibration differentiation method of testing pipe lines for leaks, such vibrations in a pipe line caused by gas, steam, air, oil, water, or other fluids escaping under pressure, traveling parallel to the axis of the pipe.

Quantitative inspection of the effect of selective damping, with respect to frequency and the relation between the components, furnishes indications from which the source of the vibrations (location of leak) can be determined. These indications show on the instrument meter.

For descriptive literature on the Model 3 VL Locator, address Western Instrument Company, 5115 Kinsie Street, Los Angeles, Calif.

"Micarta" by Westinghouse

● "MICARTA" is an unique product of Westinghouse. It is at once an insulating material against heat and electricity and is of highly acid and alkali resistant composition.

From the descriptive literature, "MICARTA" appears to be a plastic with many applications in molded or sheet form. For instance, it is employed for insulating refrigerators; for making noiseless and tough gears; for making valves for heavy duty pumps; bearings for shafts; acid tanks; in fact for any duty wherein corrosion or under water lubrication is a problem.

"MICARTA" weighs only half as much as aluminum; is stronger than Cast Iron; is non-absorbent; won't warp, chip, craze or crack. "MICARTA" bearings are water lubricated; is highly satisfactory for laboratory table tops and desk tops; resists cigarette burns.

For further information write Westinghouse, East Pittsburgh, Pa.

Jeffrey Feeder Gets New Dress

● Encased in an attractive streamlined metal sheath, a new model "Waytrol" electric vibrating feeder and weighing mechanism has been introduced by the Jeffrey Company, Columbus, O. [The styling was done under direction of Harold Van Doren & Associates, Toledo, O., industrial designers.]

The device incorporates an electric vibrating feeder, synchronized to a continuous weigh belt in an enclosed dust-proof case, the only opening in which is the window to view the calibration on the weighing conveyor scale.

A continuous flow of materials is accomplished by the electrical vibrating feeder, the amplitude of the feeder stroke being accurately regulated by a continuous belt conveyor over which the material moves. The conveyor itself is, in fact, one arm of a weighing scale, and too much material or too little instantly causes the vibrating feeder to speed up or slow down.

For descriptive bulletin, write Jeffrey Mfg. Co., Columbus, Ohio.

RUST PENETRATING COATINGS (Stop Rear Attack)

● In years past it was considered of prime importance to clean corroded metal surfaces down to the bare metal before applying any form of protective coating. In recent years priming materials have been developed which have the properties of making the adherent film serve as an integral part of the priming material, which in turn serves as a bond for the protective coating or paint applied as the second coat.

"RUSTAREST" is one of these rust penetrating primers (brushed or sprayed on) which has been successfully employed now for nine years. The material is known as a rust neutralizer and preventer of *rear attack*. It penetrates all rust left after simple wire brushing to remove blisters and loose rust. Result, production of a type of dense oxide cement of low porosity and high bonding properties. Twenty-four hours later may be applied the surface coating of any desired material, other than lacquers or synthetic resins.

Paint makers have a slogan—"Save the Surface and Save All." A "RUSTAREST" slogan might be: "Stop the Rear Attack and the Surface Takes Care of Itself."

"CORROSAL" is another product advocated in metal surface preparation. Its base is phosphoric acid. Applied with a sponge, the oxide rust is changed chemically to the passive gray iron phosphate. The latter is an inhibiting agent, as now proved in the latest development of pickling steel plates employed in tank construction with phosphoric acid.

For maximum protection insurance, the manufacturers advocate wire brushing, then a "Corrosal" wash followed by "RUSTAREST" primer to cement the passivated phosphate powder, (and residual oxide if any) to the surface. The big economy is in labor saved in surface cleaning; the big result is prevention of subsequent *rear-attack*. For descriptive "RUSTAREST" booklet quoting prices, write International Rustproofing Corp., 12507 Plover Ave., Cleveland, Ohio.

New Flow Recorder for Displacement Meters

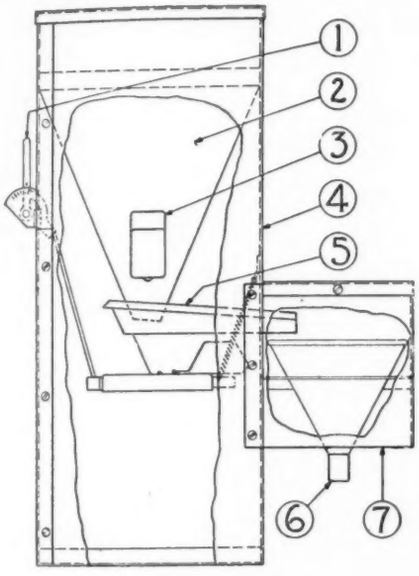
● Now a flow recorder, designed for attaching to displacement type meters is available from Bailey Meter Company of Cleveland. It indicates and records rate of flow continuously through electrical transmission, long or short distances.

This device employs the Bailey Synchro-Meter electrical transmitting method. The flow recording attachment draws a graph of rate-of-flow against time, instead of simply recording total flow over a given time.

The device is particularly useful to indicate and record flows into certain sections of pipe systems merely by inserting a displacement meter in the line, or in a bypass. Also for recording variations in rates of draft by important customers and likewise for determining the proper meter for such services. It is also useful for recording speed of slowly revolving shafts.

For an illustrated bulletin and complete description write Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, O.

Syntron's Low Capacity Feeder



● The Syntron Company of Homer City, Pa., has recently placed on the market a new model of their vibratory type dry chemical feeder.

This new machine is similar to other models of Syntron Vibratory Dry Chemical Feeders, except that it is of smaller capacity, to provide a range of feed (and price) suitable to the smaller water and sewage treatment plants.

The machine is made up of a dust-type cabinet incorporating a 3 cu. ft. supply hopper, equipped with a noiseless electric vibrator (3)* to prevent any arching over and plugging in the hopper. The vibratory feeder-conveyor trough (5) discharges into an earthen-ware solution pot (vortex type) (6) contained in an extension cabinet enclosure (7) so that the moisture around the solution pot will not affect the material in the main part of the machine itself.

A separate electric control panel (110 volt A.C.) contains the calibrated rheostat and ammeters for setting and controlling the rate of feed, which is done by varying the intensity of vibration.

For further details write Syntron Co., 650 Lexington Ave., Homer City, Pa.

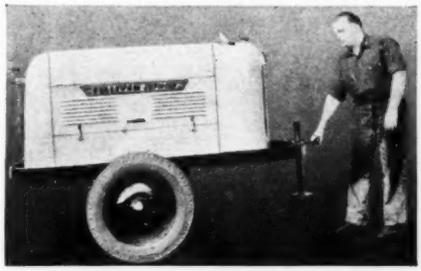
(*Numbers refer to those in the cut.)

NEW PORTABLE COMPRESSORS

By Sullivan

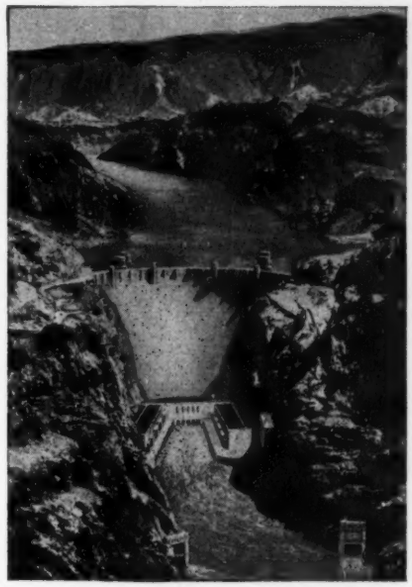
● The Sullivan Machinery Co., makers of a large line of compressors, announce a completely new line, known as the "ZEPH-AIR."

The new design features compact construction, self starters and refinement of other details to provide extreme mobility and ease of operation. (See cut.)



Two sizes are available with capacities of 60 and 85 cubic feet per minute. Although these compressors have capacity for a variety of services they are so small and compact that the two-wheel mountings can be towed by a pleasure car. Or, models on skids can be mounted in the body of a ors have come to be about the mose useful standard pick-up truck. Portable compress- "tool" in water works operations, as partially indicated in articles which appear in the Reference and Data service of this organization.

For the new "ZEPH-AIR" Bul. A-24 write Sullivan Machinery Co., Michigan City, Ind.



Bailey Meters AT BOULDER DAM

● In Boulder Dam Power Plant as in many other new hydro-electric stations including Madden Dam and Norris Dam, Bailey Fluid Meters are installed on hydraulic turbines.

At Boulder Canyon, the Bailey Meters measure water supply through 13 foot diameter penstocks under an average head of 530 feet. These meters indicate and record the water flow in terms of cubic feet per second and continuously integrate in millions of cubic feet. The registers are operated by pressure connections in the turbine scroll casings.

While your project probably does not entail the volume and head of water that is being measured at Boulder Canyon, it is nevertheless, important that your measurements of flow and liquid level be accurately made by reliable equipment.

Write for complete information on the application of Bailey Meters to your problem. MU-19

BAILEY METER • COMPANY •

1072 Ivanhoe Road, Cleveland, Ohio

BAILEY METER COMPANY LTD., MONTREAL

FERRIC ISCO CHLORIDE

Simple to Use • Low in Cost

IN SLUDGE CONDITIONING — Better Performance at reduced cost, including that of dewatering equipment. Boosts filtration rate.

In COAGULATING SEWAGE — Flexibility to handle plant overloads. Greater removal of suspended solids. Improved effluent.

In WATER FILTRATION — A practical and economical coagulant, giving quick forming, fast setting floc.

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Chicago Cleveland Boston
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Manufacturers of
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Self-priming Centrifugal and Contractors Pumps

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YEOMANS
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Simplex Rotary Distributors
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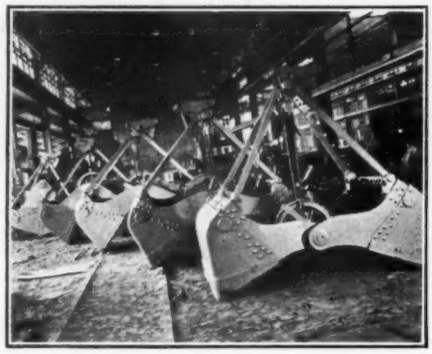
Sump Pumps

RALPH B. CARTER CO.
Engineering Office
53 PARK PLACE NEW YORK
Main Office and Factory
195 Atlantic St. Hackensack, N. J.

WITH THE MANUFACTURERS

Improved Grab Buckets for Incinerator Plants



● An improved power-wheel all-alloy steel bucket for use in incinerator plants has been introduced by Blaw-Knox Company, Pittsburgh, Pa. The accompanying illustration is a shop photo of five of these buckets which were recently constructed for incinerator plants at Cedar Rapids, Iowa; New Rochelle, N. Y.; Schenectady, N. Y.; and Cincinnati, Ohio.

The new buckets are of 1½ cubic yard size. They are built for fast action and low headroom conditions. Note the scoop design and liberal spread to reach the ends of the pits. Circular wearing pads on the sides of the scoop protect the rivet heads from abrasive contact with the concrete sides of refuse pits.

A new feature is the use of cable rather than chain on the power wheel; this cable is connected with an equalizer in the head. The objective in designing the power wheel for the use of cable was to reduce maintenance costs; it also permits use of the good sections from worn-out hoisting lines. It is believed that these are the first all-alloy incinerator buckets.

For further information write Blaw-Knox Co., Pittsburgh, Pa.

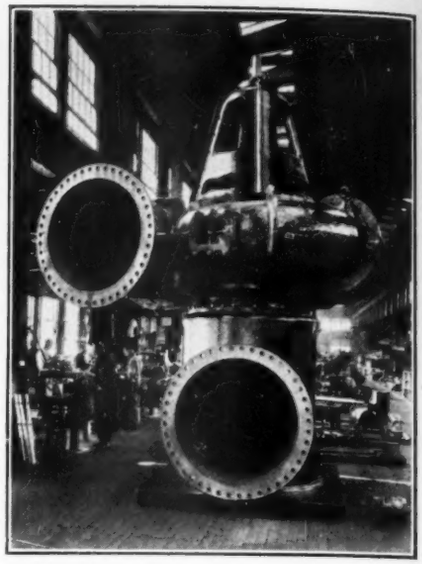
POSITION WANTED

Graduate Civil Engineer, with 13 years in municipal and sanitary engineering desires association with consulting engineer. Recently completed large water supply project, as engineer in charge of design and construction. A.A.A., % Water Works and Sewerage, 155 East 44th St., New York City.

Sanitary Chemist—Desires position in a sewage or waterworks plant. Record—Chief Chemist of Chemical Treatment Sewage Plant, 2 years; Chemist and Bacteriologist for Illinois State Water Survey, 2 years; U. of Illinois graduate—B.S. in Chemistry; graduate in sewage—2 yrs. Age—28; married; available at once; go anywhere; reasonable salary.—Address "S.C.," c/o Water Works & Sewerage, 155 East 44th St., New York.

Superintendent or Chemist: Water or Sewage. Experience 10 years Chemist in Charge of large water treatment plant, 1½ years Engineer of small group of private water companies. Age 38, married, excellent references. Address "E.L.B." care Water Works & Sewerage, 155 East 44th St., New York City.

400,000,000 G.P.D. of Warren Pumps for Flood Control



● What is believed to be the largest pumping installation for flood control in the East is that of the Springfield (Mass.) Flood Control Project. The most recent pumps ordered for the project—the two 48-inch Warren Pumps, (one unit being pictured here), brings the daily pumping capacity to practically 400 m.g.d. Each of the new 48-in. pumps has a capacity of 75,000,000 gals. per day.

In addition to these two giant pumps, Warren has previously supplied 7 30-in. pumps, with capacities of better than 30 m.g.d. each and 2 20-in. pumps with capacities of 15 m.g.d. each, making a total of almost 400 m.g.d. pumping capacity.

"Flexible Glass" Tubing

● Non-breakable transparent tubing of "Flexible Glass" should find many applications in water, sewage and swimming pool practices. Such tubing, which resembles glass, can be smoothly bent by heating sand filled sections in hot-water and bending to suit requirements.

It is reported that solutions of the strength ordinarily employed in water and sewage treatment do not etch these tubes and that the material costs little if any more than high grade glass tubing.

For a sample, size list, and prices of "Flexible Glass" tubing, write Nixon Nitration Works, Nixon, New Jersey.

Chain Belt Company Enlarges New York Office

● Chain Belt Company, Milwaukee manufacturers of the well known "REX" equipment for water and sewage plants, announce the establishment of their New York office in larger quarters.

The new location is in the modern News Building, 220 East 42nd St., New York City. W. H. Quinn, who continues as District Manager, is assisted by sales engineers, J. L. Roberts and J. L. Robinson.

W. C. STEVENS OF CUTLER-HAMMER DIES

W. C. Stevens

Cutler - Hammer, Inc., of Milwaukee, announce the sudden death of William C. Stevens, Vice President in Charge of Engineering.

Mr. Stevens, a Cornell graduate in Mechanical Engineering (1906), began his successful career with Cutler-Hammer that same year. Eleven years later he was General Sales Manager, and in 1924 became head of the Development and Research Department. Since 1930 he has held the position of Vice President in Charge of Engineering, and was also Secretary and a Director of the Company.

Interesting Meter Installation By Sparling

● The Palos Verdes Reservoir of the Metropolitan Water District of Southern California will float on the line as a storing and feeding unit—there being inflow at night, outflow during peak demand hours. Specifications for metering equipment called for a reversing (two way) meter to measure accurately all inflow and all outflow. The successful bidder was R. W. Sparling of Los Angeles, who supplied the unit (for a 36 in. restriction) capable of accurately measuring flow in either direction over a range of 2 to 50 m.g.d. The Sparling Main Line Meter of the propeller type will operate indicating, totalizing and recording instruments. The Sparling Recorders are mechanically operated through cables, in order to remain independent of all electrical service. Chart changes are at seven day intervals only.

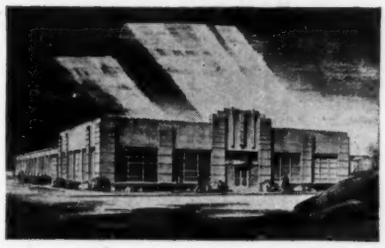
Col. Vaughn Awarded Schoellkopf Medal

● The Schoellkopf Medal for 1939 has been awarded Charles F. Vaughn, Plant Manager of the Mathieson Alkali Works at Niagara Falls.

This award was voted Mr. Vaughn by the American Chemical Society, as "an outstanding man in the chlorine and alkali industry." He was cited for his successful development of the improved Castner mercury-cell for chlorine production, and his ability as an executive and administrator.

Colonel Vaughn served as Lieutenant Colonel in the Chemical Warfare Service during the World War. During this service he designed and built the largest chlorine plant in the world at Edgewood Arsenal (Md.), and was given complete charge of chlorine operations for the War Department.

LINK-BELT'S NEW DALLAS HOME



From E. G. Wendell, District Manager of Link-Belt Co.'s southwestern territory, comes news of the construction of a new warehouse and office building for Link-Belt in Dallas, Texas. The accompanying picture reveals the artist's drawing of the 105 x 225 ft. warehouse, in every detail modern, and also machine shop equipped. The air conditioned and soundproofed office section faces on Latimer St. Until completed the Dallas offices and warehouse will continue at the present location established since 1934 at 413 Second Ave. The company also maintains a branch sales office in Houston.

Nice Order

● For the Delaware Aqueduct under construction by the New York City Board of Water Supply,— one million pounds of bronze castings are to be supplied by the Bartlett Hayward division (Baltimore) of the Koppers Company for the various shafts on this project.

MULTI-ZONE FURNACES

CONSTRUCT - DESIGN - SUPERVISE - UNDERPINNING AND FOUNDATION CO. - 155 EAST 44TH ST. - NEW YORK

For Incineration of SEWAGE SLUDGE, SCREENINGS, GROUND GARBAGE

Operation is without auxiliary fuel—odorless!

- SEPARATE DRYING AND INCINERATING ZONE.
- FLEXIBLE AND AUTOMATIC TEMPERATURE CONTROL.
- ALL GASES COMPLETELY DEODORIZED.
- RESIDUE UNIFORM, INERT, NON-OFFENSIVE ASH.
- OPERATING RESULTS POSITIVE AND LOW IN COST.

INSTALLATIONS AT
Niagara Falls, N. Y.
Milwaukee, Wis.
Lansing, Mich.
Raritan, N. J.

MULTI-ZONE FURNACES

Embody Greatly Improved Principles of Multiple Hearth Operation

UNDERPINNING & FOUNDATION CO., Inc.
155 East 44th St.
NEW YORK, N. Y.

COMPLEX or SIMPLE

All Joints look alike to this* INGOT *Form Compound

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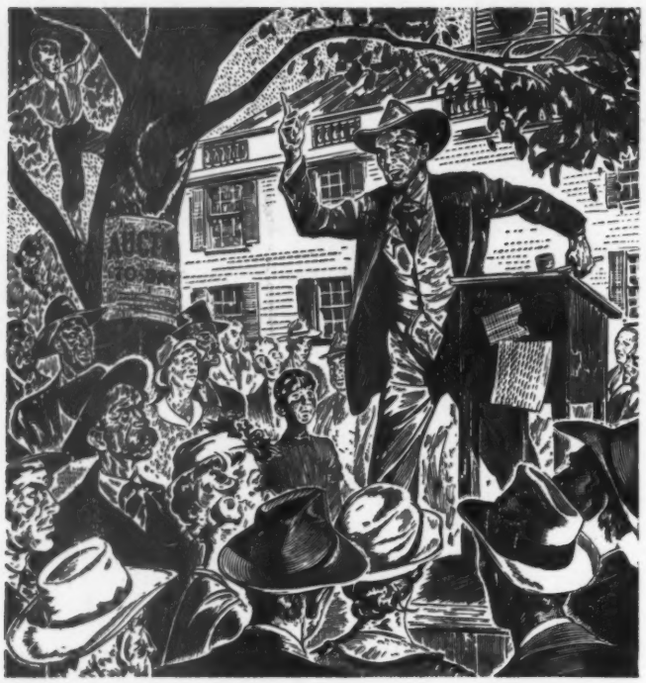

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MEETINGS SCHEDULED

June 28—SWAMPSCOTT, MASS. (The New Ocean House.)
New England Water Works Association (Annual Outing). Sec'y., Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

June 26-28—STATE COLLEGE, PA. (Nittany Lion Inn and Dormitories.)
Pennsylvania Sewage Works Ass'n. Sec'y-Treas., L. D. Matter, Distr. Eng'r., Kirby Health Center, Wilkes-Barre, Pa.

June 28-30—STATE COLLEGE, PA. Nittany Lion Inn and **Pennsylvania Water Works Operators' Association.** Sec'y-Treas., I. M. Glace, 22 South 22nd St., Harrisburg, Pa. Dormitories)

Aug. 24-25—DULUTH, MINN. (Hotel Duluth)
Minnesota Section A.W.W.A. Sec'y-Treas., R. M. Finch. W. & T. Co., 416 Flour Exchange, Minneapolis, Minn.

Sept. 7-8—UNIVERSITY OF VIRGINIA (Monroe Hall)
Virginia Section A.W.W.A. Sec'y., H. W. Snidow, State Dept. of Health, Richmond, Va.

Sept. 12-15—MONTREAL, QUEBEC, (Hotel Windsor)
New England Water Wk's. Ass'n. (Annual Convention). Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston.

Sept. 18-19—DENVER, COLO. (Shirley-Savoy Hotel)
Rocky Mountain Section A.W.W.A., Sec'y., B. V. Howe, State Office Bldg., Denver, Colo.

Sept. 18-20—JOHNSTOWN, PA.
Western Pennsylvania Section A.W.W.A., Sec'y., E. P. Johnson, 418 Flannery Bldg., Pittsburgh, Pa.

Sept. 20-22—LANSING, MICH. (Olds Hotel)
Michigan Section A.W.W.A. Sec'y, M. N. Gerardy, Water Board Bldg., Detroit, Mich.

Meeting Jointly with

Michigan Conference Water Purification. Sec'y-Treas., R. J. Faust, Michigan Dept. Health, Saginaw, Mich.

Sept. 25-26—DICKINSON, N. D.
North Dakota Water & Sewage Conference. Sec'y-Treas., L. K. Clark, Bismarck, N. D.

Sept. 28-30—MORGANTOWN, W. VA. (Morgan Hotel)
West Virginia Section A.W.W.A. & West Virginia Conference on Water Purification (Joint Meeting). Sec'y.-Treas., J. B. Harrington, State Dept. Health, Charleston, W. Va.

Oct. 5-6—READING, PA. (Berkshire Hotel)
Four States Section A.W.W.A. Sec'y-Treas., Carl A. Heckmer, Washington Sub. San. District, Hyattsville, Md.

Oct. 9-11—PITTSBURGH, PA. (Hotel Wm. Penn)
American Public Works Association, Exec. Director, Frank W. Herring, 1313 East 60th St., Chicago, Ill.

Oct. 11-13—KANSAS CITY, MO. (Hotel President)
Missouri Valley A.W.W.A. Sec'y., Earl L. Waterman, University of Iowa, Iowa City, Ia.

Oct. 16-19—DALLAS, TEXAS
Southwest Section A.W.W.A. Sec'y-Treas., Lewis A. Quigley, 3320 West Berry St., Fort Worth, Texas.

Oct. 17-20—PITTSBURGH, PA. (Hotel William Penn)
American Public Health Association. (68th Annual Meeting.) Exec-Sec'y., Dr. Reginald M. Atwater, 50 West 50th St., New York City.

Oct. 19-21—ATLANTIC CITY, N. J. (Hotel Haddon Hall)
Pennsylvania Water Works Association. (Annual Meeting.) Sec'y, F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 19-20—HAMILTON, ONT. (Royal Connaught Hotel)
Canadian Institute on Sewage & Sanitation. Sec'y-Treas., A. E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto, Ont.

Oct. 20-21—ATLANTIC CITY, N. J. (Claridge Hotel)
New Jersey Section A.W.W.A. Sec'y, H. N. Lendall, Rutgers University, New Brunswick, N. J.

Oct. 25-28—SAN FRANCISCO, CALIF.
California Section A.W.W.A. Sec'y-Treas., Burton S. Grant, Civil Engr., Bureau of Water, Los Angeles, Calif.

Oct. 30-Nov. 1—OSHKOSH, WISC.
Wisconsin Section, A.W.W.A. Sec'y-Treas., Leon A. Smith, Supt., Water Dept., City Hall, Madison, Wisc.

Nov. 6-8—CHARLOTTE, N. C.
North Carolina Section A.W.W.A., Sec'y., R. S. Phillips, 206 Dacian Ave., Durham, N. C.

CATALOGS AND LITERATURE

"ROTOVALVES—by Smith"—is a new bulletin of 96 pages from S. Morgan Smith Co. of York, Pa., a firm which for more than 60 years has been serving the hydraulics field. The bulletin states its own case very aptly, in announcing that—"This bulletin, in essence is a Text Book on Conical Plug Valves". Further —"It presents for the first time a summation of the findings, development and available data pertinent to the use of this type of valve in its many and diverse applications. It is our hope that it will be useful to the engineers of the water works and sewerage fields, especially".

The bulletin is filled with excellent pictures of ROTOVALVES (6 to 60-inch) installed for one or another service on water, sewage and air lines in representative water works and sewage treatment plants. Detailed design is shown of styles used as surge-relief valves, checks, altitude valves, automatic stop valves for protection in line failures, flow control and pressure reduction units. In the rear of the bulletin are several pages of useful reference data including loss of head graphs for various styles of valves and checks as compared with that through ROTOVALVES of equal size at equal flows. For a copy of Bulletin No. 140 write S. Morgan Smith Co., York, Pa.

"Automatic Supervision of Chlorination"—is W. & T.'s answer to the problem of *continuity* in sterilization practice. In a folder, just released by Wallace & Tiernan Co., three types of indicators, recorders and totalizers for hooking up chlorinating equipment are described and pictured. The purpose is that of spotting operating failures, stopping alibis, and providing proof that there was continuity and sufficiency of chlorination during periods for which the charted records are the proof. Even for the small manually controlled chlorinator there is a recorder which produces a simple picture of chlorination happenings 1440 minutes of the day. The most elaborate is the central recording station into which chlorine feed records come in over telemetering equipment to the recorder. This new line of equipment was first displayed at the recent Water Works Convention in Atlantic City. It is described in bulletins, available upon request to Wallace & Tiernan, Newark, N. J.

"Grit Washing"—is the subject of a recent Jeffrey bulletin which describes the new Grit Jig, developed by Jeffrey Mfg. Co. for continuous efficient washing of sewage grit. The new washer is patterned after the efficient ore washing jigs or classifiers and is guaranteed to remove at least 80%, and up to 90%, of the putrescible matter from sewage grit—including the objectionable odor producing grease. Sketches picture the principle on which the scouring washer operates. A description, in detail, follows and, with it, operating results. For a copy of Catalog 698 wrte Jeffrey Mfg. Co., Sanitation Division, Columbus, Ohio.

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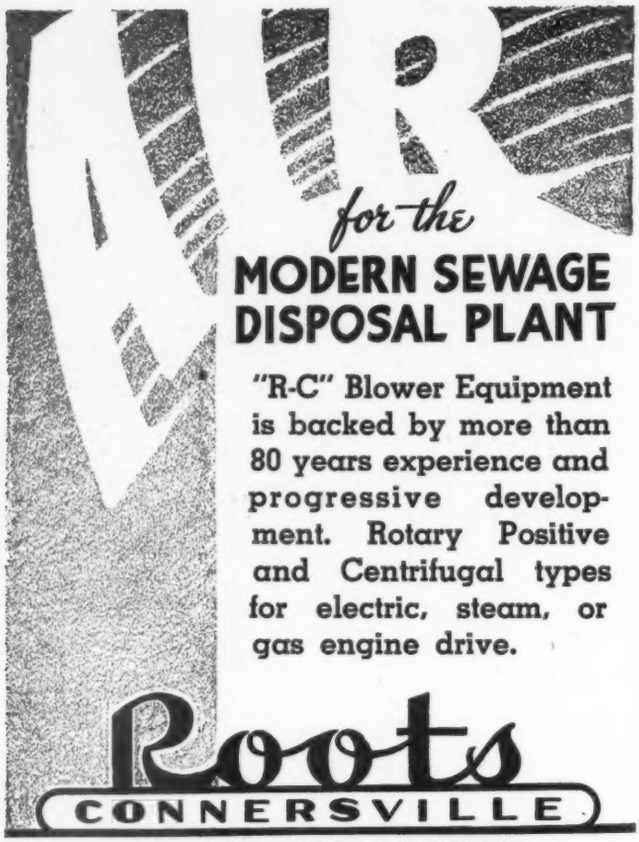
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"Activated News"—is a monthly publication issued by Activated Alum Corp. of Baltimore, Md. Every issue contains some short pithy paragraphs on "How the Other Fellow Does It"—in short "Kinks and Gadgets". Then there are items which might be termed "News from the Field". If you are not on the mailing list for "Activated Alum News" you should be —and can be, just by dropping a card to Activated Alum Corp., Curtis Bay, Baltimore, Md.

"The Simplex SUMMATOR"—is described in a new bulletin from Simplex Valve and Meter Co. The Summator does what its name implies—brings together individual meter flow indications, from remote points, to one or more master stations. The instrument, therefore, discloses what a mastermeter instrument would—viz., the total output of a plant, filtering rates, etc., and records such on a single master-chart. The instruments are described and illustrated, and listed as to locations in important plants. Specifications stipulate accuracies within 2%. For "SUMMATOR" Bul. No. 70 write Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

"Catalog No. 800"—is the largest and most comprehensive General Catalog ever issued by Link Belt Co. It contains 1278 pages—with 44 pages of pictorial preview of Link-Belt's varied equipment, and the closing 29 pages devoted to hand-book information useful to engineers, designers and operators. This catalog is not intended for general distribution because of its costliness and limited printing. Those who have just need for a copy may secure one by writing on his firm's letterhead. Address, Link-Belt Co., 307 No. Michigan Blvd., Chicago, Ill.

"Spaulding Precipitators"—are the subject of a new Permutit bulletin which describes the features, and the technical and economic advantages of the Spaulding Precipitator, which makes possible a materially smaller plant for softening water by the lime or lime soda process, at the same time producing a water of less residual hardness, the elimination of recarbonation and sludge removal mechanisms, also improved chemical economy in most instances. For Bulletin No. 2204, write The Permutit Co., 330 West 42nd Street, New York City.

"Recarbonators"—offered by International Filter Co. for stabilizing lime softened water, are presented in a new Infilco catalog. The improved units consist of burner (producer) cooling and scrubbing unit, drying unit and compressor or pump. Producing units are supplied for a variety of fuels. Drawings and photographs reveal the compactness of the connected units. For a copy of Bul. 1300 write International Filter Co., 59 East Van Buren St., Chicago, Ill.

"Link-Belt Screens" are presented in a folder from Link-Belt Company. First there are the well known "Straightline" mechanically raked automatic bar-screens, with specifications and detailed drawings. Then follows the newer "Tritor Screen" which is a combination screen and grit chamber equipped with adjustable baffles to maintain grit separating velocities. It is also mechanically cleaned. For folder No. 1587 write Link-Belt Co., 2045 Hunting Park Ave., Philadelphia, Pa.

"Water Level Recorders—by Gurley"—are described in a new bulletin from W. and L. E. Gurley of Troy, N. Y., manufacturers of hydraulic instruments for 30 years or better. In the new bulletin are presented the features of the newest Gurley Graphic Water Level

Recorders for water and sewage flow, reservoir levels and stream stage recording. One model is equipped for wired transmission from the gage to the remote recording instrument. One type provides a continuous graph while another prints elevations at intervals on a tape. For Bul. 600 write W. & L. E. Gurley, Troy, N. Y.

"Utility Air Compressors"—Is a new 16-page catalog by Schramm, Inc., which presents their complete line of "Utility" Stationary Air Compressors for general application. Sizes from 85 to 600 cu. ft. capacity are listed in an assortment of assemblies, ranging from a bare compressor unit to complete plants with electric motor, air receiver and all fittings, ready for operation. Either "V" belt dive or a compact "built-in" direct motor drive can be furnished. Operating data, detailed specifications and pictorial design features are included. For bulletin 3907-WW, write Schramm, Inc., West Chester, Pa.

"Waterproofed Concrete"—Everyone concerned with waterproofed concrete will find worthwhile information in Medusa's 36-page book, "How To Make *Good* Waterproofed Concrete". This book tells why concrete, stucco, masonry and mortar should be waterproofed during *original* construction. It explains the essentials of good waterproofed concrete and the advantages of Medusa's "waterproofed cement," in concrete construction for both above and below grade structures, to assure complete protection against disintegration as well as wall dampness. Specifications are given for waterproofing all types of walls and floors, both above and below grade. Another important section is that giving specifications for waterproofing *existing* concrete work. For a copy of "How To Make *good* Waterproofed Concrete" write Medusa Portland Cement Co., 1000 Midland Bldg., Cleveland, Ohio.

"Protection for Water and Sewer Lines"—is the subject covered in a new Wailes Dove-Hermiston bulletin which recounts the history behind "Bitumastic" coal-tar enamel, or paint, in metal protection against underwater and atmospheric or ground corrosion. Performance records are cited for the coal-tar base product which dates back to 1914 for water mains—1912 for the lock gates of the Panama Canal. The story of Bitumastic Enamel is largely told in pictures of pipe line projects in which the coating has been used and their case histories. If interested write Wailes Dove-Hermiston Corporation, 17 Battery Place, New York.

"Wilson Hypo-Chlorinators"—are described and illustrated in a bulletin from Wilson Feeders, Inc. These feeders provide proportional automatic chlorination when connected to the up and down stream sides of an orifice or Venturi meter. They employ a solution of hypochlorite. For a copy of the bulletin, write Wilson Feeders, Inc., Buffalo, New York.

"pH APPARATUS"—A new 40-page illustrated Leeds & Northrup catalog on "Apparatus for Electrolytic Conductivity Measurements in Laboratory and Plant" describes and lists the latest forms of L. & N. apparatus for making all well-established electrolytic conducting measurements including pH. measurements. It contains a general discussion of research, routine and industrial measurements and includes information on recent developments in technique and apparatus for precise measurements. For a copy of Cat. EN-95, write Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.

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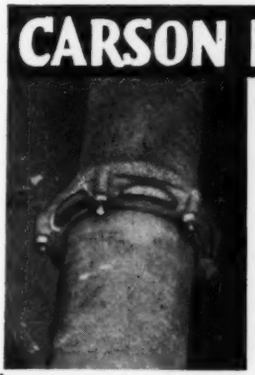

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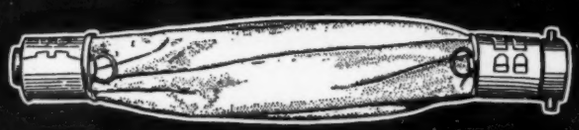

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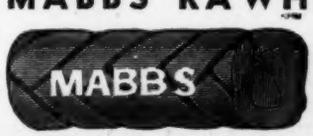

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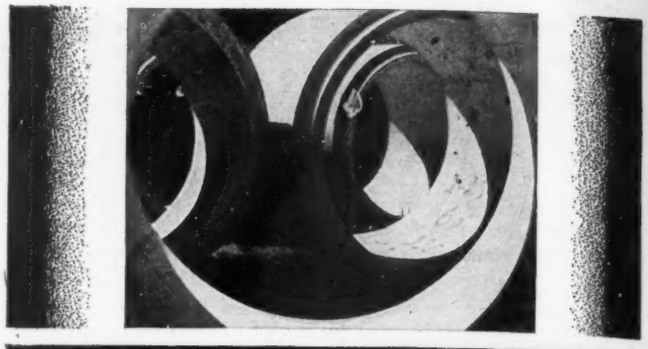

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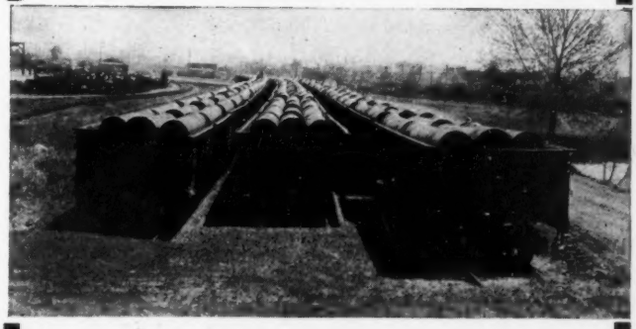

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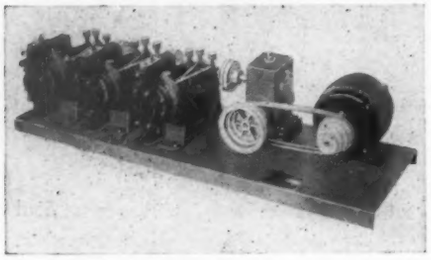

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2

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3

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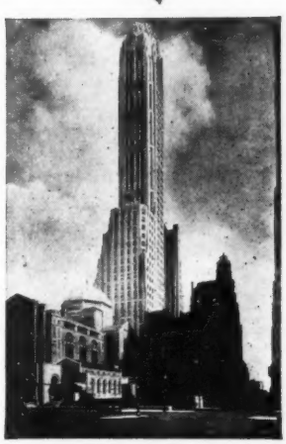

Dorr headquarters in New York
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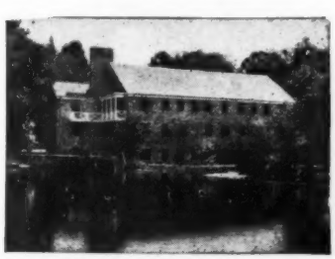
570 Lexington Avenue



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The Westport Mill
Westport, Conn.

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Carried along in the influent to New York we know there will be many Dorr clients and friends from all over the world. We want them to see how we are planning now for the sanitation of tomorrow at our New York offices—how we are developing new techniques in sewage, water and waste treatment at our Westport Mill.

The doors of the Dorr offices and Dorr laboratories are always open to Dorr clients and friends—consulting sanitary engineers, city engineers and municipal officials.

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That, Mister, is the "Why" of W&T service—an ideal of RESPONSIBILITY upon which has been built the world's largest chlorinator business, a twenty-five year record of complete dependability in advancement and protection of the public health.

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